Using Remote Sensing to Map In-Field Variability of Peanut Maturity – Final Report

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Objective: Determine the feasibility of using remote sensing to map in-field variability of peanut maturity and quality

Work Conducted in 2020:

The study was conducted in two irrigated peanut fields – a grower's field in Tift County and the NESPAL field on the University of Georgia Tifton campus. Both fields were planted to Georgia-06G. Historical satellite images of the grower's field were analyzed to characterize soil variability. Twelve sampling locations distributed on three transects were established to capture soil variability and topographic differences (Figure 1). The NESPAL field is divided into six blocks each approximately 0.8 ac in size. Two sampling locations were established in each of the blocks. In each field, ten peanut plants were collected from an area approximately 30 ft in radius around the sampling point weekly for the 6 weeks prior to harvest. Approximately two hundred peanut pods were removed from each group of plants and pressure-washed to expose the mesocarp. The pods were placed on the Peanut Profile Board (PPB) and the number of nuts in each color class recorded. Figure 2 shows the maturity distribution from the grower's field for the final sampling event prior to harvest. The graph includes the total number of pods from all 12 sampling points. The peanut maturity index (PMI) was also calculated for each sampling point. PMI is calculated as the percentage of brown and black pods of the total number of pods. A PMI of 70 is thought to indicate optimal maturity. Figure 1 shows the PMI at each of the 12 sampling points for the final sampling event prior to harvest. The spatial variability of maturity in this field is clearly seen as PMI ranged from 46 to 73.

During each sampling day, a Parrot Sequoia camera attached to a 3DR Solo quadcopter UAV was used to capture multispectral images in 4 different bands; Green (530-570 nm), Red (640-680 nm), NIR (770-810 nm) and Red Edge (730-740 nm). All UAV flights were performed within 2 hours of solar noon from an altitude of 90 m with 70% overlap. At 300 ft, the spatial resolution of the camera was 3.75 in. Pix4D software was used to create mosaics of reflectance maps in each one the four bands and the ArcGIS software was used to extract an average reflectance value for the pixels in 2.5 ac grid cells around the sampling points in the grower's field. The same process was repeated for the NESPAL field where the data were extracted for the area of the block that contained each sampling point (approximately half a block per sampling point). A full 7-day workweek by two students is required to collect, process, and analyze the samples from each field. The image and statistical analyses are still in progress.

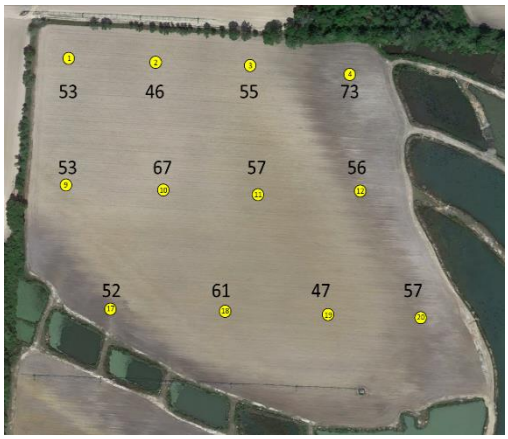

Figure 1. The 12 sampling locations in the grower's field are indicated by the yellow circles. The black numbers above or below the circles indicate PMI for the final sampling event prior to harvest (13 October 2020). PMI is calculated as the percentage of brown and black pods of the total number of pods. A PMI of 70 is thought to indicate optimal maturity. The spatial variability of maturity in this field is clearly seen as PMI ranged from 46 to 73.

The seven vegetation indices (VIs) and three modified VIs used in the 2019 study are being used for to evaluate their maturity prediction strength with the 2020 fields (Figure 2). The average reflectance values for each grid cell are used to calculate the response of the ten VIs for each sampling date. Pearson's correlation ($p<0.001$) and regression analysis are used to compare the response of the VIs to PMI.

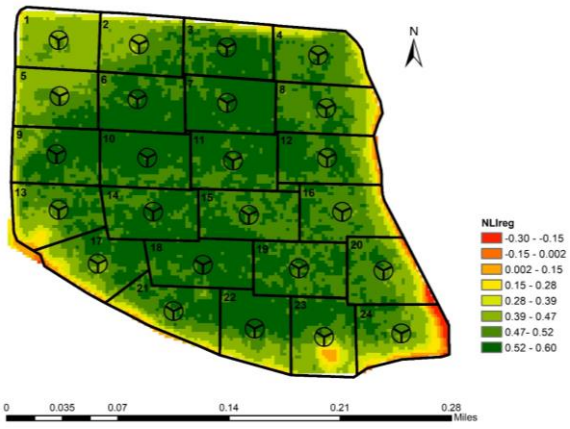

Figure 2. VI map of the grower's peanut field from 13 October 2020 that shows the variability in the crop canopy likely a result of variability in maturity.