TITLE: USING VEGETATION INDICES TO DETERMINE PEANUT MATURITY (CPES-163-09/10)

FY 2010 REPORT SUBMITTED TO: Georgia Agricultural Commodity Commission for Peanuts

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OBJECTIVE: Using vegetation indices to determine peanut maturity

FINDINGS:
During the 2009 growing season, we received $5000 from the Peanut Commission to test our hypothesis that we could use vegetation indices (VIs) to predict peanut maturity. VIs are mathematical ratios of the amount of light reflected by plant canopies at specific wavebands (green, red, NIR, etc.) Reflectance is a measure of the percentage of sunlight reflected by plants at those wavelengths and can be measured with tractor-mounted sensors like the Crop Circle®.

We conducted the 2009 study at the University of Georgia's Ponder Farm on 14 peanut varieties. The peanuts were planted in a replicated random block design intended for a planting date/peanut maturity experiment being conducted by Dr. John Beasley (Figure 1). Two different planting dates were used: April 20 and June 08. This experiment provided an excellent opportunity for us to leverage Peanut Commission funding and measure the response of currently popular and new peanut varieties.

We monitored the reflectance response of all 14 varieties weekly from August 18 until digging. This resulted in 5 reflectance data sets from the first planting date and 10 from the second planting date. Peanut samples were collected and maturity measured using the hull-scrape method 5 times for the first planting date and 6 times for the second planting date. The peanuts from the first planting date (April 20) were inverted on September 18 while the peanuts from the second planting date (June 08) were inverted on October 23.

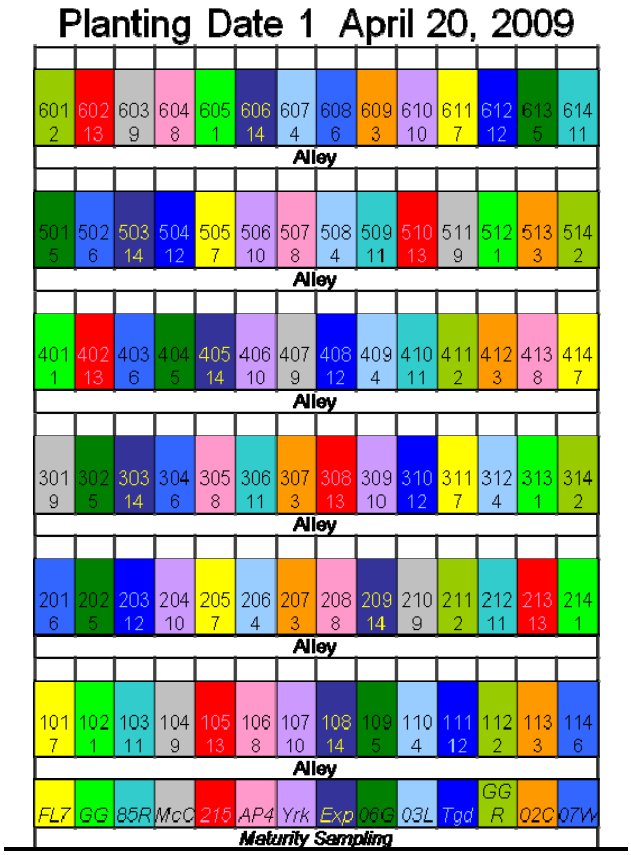

Figure 1. Schematic showing the experimental design of the first planting date. Samples for the hull-scrape tests were collected from the plots at the very bottom of the schematic.

The reflectance data were used to calculate six different VIs with potential for predicting peanut maturity. The response of the VIs over time was graphed with the goal of identifying a pattern which indicates maturity. For example, in Figure 2 you see the response of the NLI (non-linear vegetation index) over time for 4 of the 14 varieties evaluated. Each cluster of bars represents the NLI response for that variety for the 5 weeks prior to when the peanuts were inverted. The last bar in each cluster represents the NLI response immediately prior to inverting. As you can see in the graph, the rate at which NLI decreased as the peanuts matured leveled off. This leveling off appears to be a good indicator of peanut maturity. The numbers above the bars indicate the days to digging estimated by the hull-scrape method. For the set of data associated with the April 20 planting date, there is a clear relationship between VI response and peanut maturity. NLI is calculated as shown below:

$$NLI = \frac{NIR^2 - RED}{NIR^2 + RED}$$

Because of deteriorating weather conditions in late October 2009, the peanuts from the June 08 planting date were inverted a week to 10 days before even the earlier maturing varieties reached full maturity. So even though we see the same general trends for the June 08 planting date as shown in Figure 2, additional research is needed to verify our observations.

An unexpected finding of our work has been that the results of the hull-scrape method are quite inconsistent as the peanuts approach maturity. If you look carefully at the days-to-digging numbers in Figure 2, you will see that for 3 of the 4 varieties, the predicted days to digging stayed about the same across three sampling periods (14 days difference). There are many potential reasons for this including human error in properly sorting the peanuts and in-field variability (the point of doing this study). However, all our samples were collected from the same small plot, so in-field variability is an unlikely cause.

CONCLUSIONS:

NLI and two other VIs appear to have great potential for serving as indicators of peanut maturity for many varieties. To verify that the 2009 observations are repeatable, the experiment must be repeated during 2010.

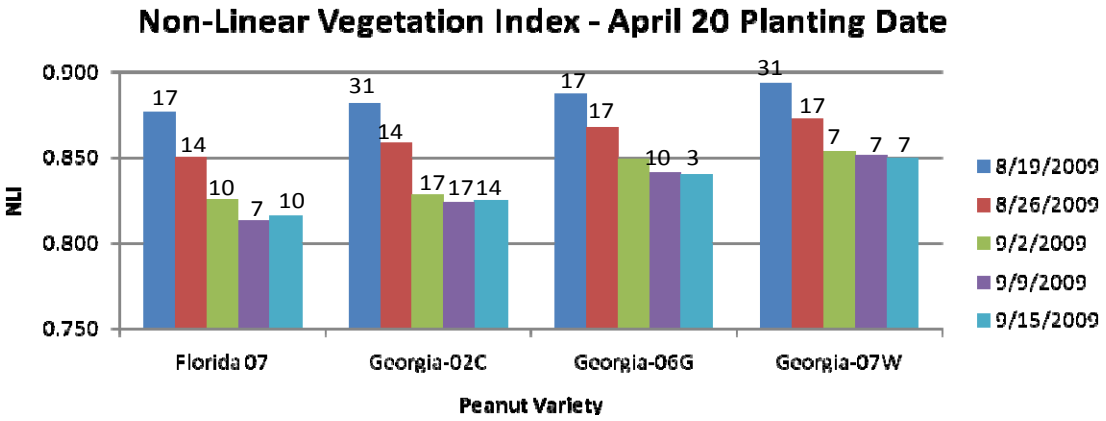

Figure 2. Non-linear vegetation index (NLI) response to peanut maturity. Each cluster of bars represents the NLI response for that variety for the 5 weeks prior to when the peanuts were inverted. The last bar in each cluster represents the NLI response immediately prior to digging. The numbers above the bars indicate the days to digging estimated by the hull-scrape method.