2015/2016 National Peanut Board/SPRI Research Proposal
Project #126505
7/31/2017

I. Identification:
Title: PeanutFARM website: continued delivery of irrigation scheduling and improved methods of peanut maturity determination
Funding Year: January 1, 2016 – December 31, 2016
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Total Funds Requested: $32,600
Locations: Florida, Georgia, Alabama
Continued Project: Three years of previous support have been received for website development; this is the first year request for maintenance and ongoing validation testing.

II. Layman’s Summary:
To remain both economically and environmentally sustainable, peanut growers require access to new technologies and tools that can maximize production through improved agronomic management of their peanut crop, including in-season and harvest decisions. With the release of the web based tool, Peanut FARM (Field Agronomic Resource Manager) funded in part by the NPB/SPRI program in 2012, 2013, and 2014 growers now have access to a suite of tools. TOOL #1: Peanut maturity predictor. An adjusted growing degree day (aGDD) model for predicting peanut maturity has been incorporated into a web platform and was launched for the 2013 growing season. TOOL #2: Irrigation Scheduling System. Launched with the aGDD tool in 2013, this tool utilizes cumulative aGDD’s and ET to estimate crop water use and provides daily irrigation recommendations. TOOL #3: PeanutPROFILE. Our team has finalized the development of a subpage on PeanutFARM where growers are able to upload images taken from a scanner and receive an automated message about when to dig. This tool uses the Digital Image Model (DIM) to assess peanut maturity and this has been shown to successfully translate the digital analysis of mesocarp color into a digging date prediction. Further, we will soon have the web app for PeanutFARM released and will require grower training and possibly troubleshooting. Now that these tools have been developed and successfully launched on a web platform (and the web app that is now in development based on NPB support in 2015), continued maintenance of these web tools as well as continued field trials validating the tools is critical.

III. Project Purpose:
Both the aGDD and DIM methods have been rigorously tested in GA, FL, and AL over the last four years and analysis of their harvest prediction is indicating at least equal performance with the widely accepted maturity profile board (Williams and Drexler, 1981), but with less analysis time and subjectivity. Accumulated aGDD values can be used to predict crop developmental stage in-season to develop both a harvest predictor (Rowland et al., 2006) and an irrigation scheduling model. The launching of these tools on a web platform has now made them freely accessible to growers across the tri-state area and beyond, with 218 growers and researchers registered as users during the 2015 growing season. Further validation testing will help us identify any problems with these models and continue to refine and perfect them. We have also been successful in launching a subpage of PeanutFARM called PeanutPROFILE that allows growers to upload images of blasted pods from a scanner and analyzes mesocarp color according to an algorithm (Digital Image Model – DIM) developed and tested over the last five years (Colvin et al., 2014). Lastly, these tools will soon be delivered on a web app platform for smartphones and this platform needs to be tested and evaluated by users. This is a multi-year project.

IV. Hypothesis and Objectives:
We hypothesize that growers can manage peanut irrigation scheduling and maturity predictions effectively through a set of weather-based algorithms centered on the calculation of aGDDs. We propose continued testing and refining these tools as well as the addition of the smartphone app platform. The specific objectives are: 1) maintain and make any required upgrades to the web tools; 2) continued testing and validation of the aGDD maturity and irrigation tools in Alabama, Georgia, and Florida; and 3) continued in-field and web testing of the DIM model for peanut pod color analysis and testing of the image upload capability on the existing PeanutPROFILE subpage. For all objectives, we expect to continue testing the aGDD model and DIM with samples collected from grower cooperator fields in AL, GA, and FL and on research plots at UF and UGA. Due to the extreme precipitation levels during the growing seasons of 2013, 2014, and for most areas in 2015, an adequate test of the irrigation scheduling tool has not been very extensive, so further testing on grower cooperator fields is necessary. Finally, the new release of these algorithms on a smartphone platform requires testing and evaluation by growers.

V. Experimental Plan and Methods:
We will accomplish the objectives through the following tasks:

**Task 1:** We will utilize a consultant who is familiar with the web and app tools to maintain the tools, insure they are working properly during the season, and field questions and communicate with growers about updates or changes to the site.

**Task 2 and 3:** Continued in-field testing of the harvest predictor, irrigation scheduling, and DIM model will be conducted on 2-3 farms or field sites in both states during the 2016 harvest season. This will be done for both the web and smartphone app platforms. We will also test and refine the method for image upload and DIM analysis capability on the existing PeanutPROFILE website, including testing the option of using smartphone pictures of pods in comparison to scans of pods.

Continued validation of the tools on PeanutFARM for current and future cultivars and regions is important for insuring the model’s performance under varying climatic and regional conditions, as well as subtle management differences for diverse genotypes. Beta testing of the irrigation scheduling model utilizing accumulated aGDD’s will be needed in 2016 because high precipitation rates during the last three years did not allow for an adequate test of the irrigation scheduling decisions.

VI. Measurable Outcomes and Potential Impacts:
The PeanutFARM website was launched during the 2013 season and currently has 218 registered growers and researchers primarily in AL, GA, and FL. Distribution via the internet of these tools has and will continue to make widespread adoption both fast and simple. Refinement of existing tools and validation of their applicability to different peanut cultivars will add beneficial economic impacts for southeastern peanut growers. For example, a 1-point average grade increase through improved harvest prediction on as few as 1% of US acres could easily pay for 2-3 years of this study. Providing an efficient irrigation scheduling tool easily delivered via the web could decrease irrigation costs and demonstrate grower stewardship of water resources.

VII. Potential Pitfalls:
None.

VIII. Results from Previous NPB funding:
**Deliverables from previous funding:** specific accomplishments include: the addition of AL weather stations on the web platform; continued testing of grower farms in GA, FL, and AL; continued research plot testing of the aGDD and DIM methods on varying cultivars; the development of a sister website, **Peanut Profile** that allows for the utilization of the DIM model on user uploaded images; and the ongoing development of a smartphone app for delivery of these tools. The results from this project have been presented at numerous grower meetings throughout the Southeast and the PIs have worked closely with growers in troubleshooting use of the site, fielding questions, and implementing changes on the website through grower suggestions.

IX. Budget: Please see attached.

X. Proposed Percentage of Any Revenue Generated by the Project to be Reinvested in Peanut Research (after payment of costs): 100%

References:
Final Results:
Troubleshooting new tools and dissemination of information:
For the 2016 growing season, we announced the new PeanutFARM website and app tools that were made available and the archiving procedure for the historical data for current PeanutFARM users. These announcements were made at grower workshops, field days, and an article through Panhandle Ag e-NEWs (http://nwdistrict.ifas.ufl.edu/phag/2016/05/20/peanutfarm-irrigation-and-harvest-tool-is-now-mobile-friendly/) (Figure 1).

Figure 1: screenshot of Panhandle News article featuring the new updates on PeanutFARM (May 20, 2016).

A trifold description was also developed and distributed at several field days (Branford, Marianna, Escambia County in 2016) in Florida (Figure 2). Grower comments were received and responded to by the UF team for the 2016 season and problems associated with the programming of the new tools was addressed.
PeanutFARM Tutorial

Step 1:
- Log onto PeanutFARM and touch "sign up" in the right hand corner.
- Make an account by registering your contact information and email address.

Step 2:
- Touch the main drop down menu and press on "initiate".
- The initiate step includes creating a form, and capability to add multiple fields, cultivars, and a weather stations.
- Within the "initiate" tab a previously filled out field can be selected from the drop down menu.
- A planting date, whether the field is under irrigation, and weather station verification can be specified for a particular field.

PeanutFARM Field Agronomic Resource Manager

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Step 4:
- Selecting "status reports" in the main drop down menu allows you to view the status of all the entered fields.

Step 5:
- A detailed history report for each field can be viewed by selecting "history report".

The closest weather station to your field will automatically be selected.
- The selected soil type and data from the weather station is used for your irrigation scheduling.

Figure 2: trifold handout developed for PeanutFARM update and instructions. This trifold was distributed at field days and grower workshops.
PeanutPROFILE:
Sample images were received through the PeanutPROFILE website for the 2016 harvest season and email recommendations were provided. A mix of images from both research groups (University of Georgia, University of Florida, and other groups) and growers were received.

PeanutFARM Validation Trials:
Field validation trials were conducted at the Plant Science Research and Education Unit (PSREU) in Citra, FL, and the Suwannee Valley Agricultural and Extension Center (SVAEC) in Live Oak, FL.

PSREU Site - 2016
Experimental design:
The field study was initiated in 2016 at the University of Florida’s Plant Science Research and Education Unit in North Central Florida (29° 24' 38" N, 82° 10' 12" W). The soil is classified as an Arredondo sand (Loamy, siliceous, semiactive, hyperthermic Grossarenic Paleudults). Daily meteorological data is being recorded using an automated weather station located within 1500 m of the experiment. Rainfall is also being collected using a rain gauge placed within 200 m of the experiment (Spectrum Technologies, Inc., Aurora, IL).

Irrigation and peanut genotypes treatments were randomized in a split plot arrangement within a randomized complete block design. Irrigation treatments are the whole plots and peanut genotype is the sub-plot. Irrigation was applied using a lateral move system equipped with variable rate irrigation (VRI) (Lindsey Corporation, Omaha, NE). The irrigation treatments included: 1) irrigation scheduled using the University of Florida’s PeanutFARM (PF) soil water mass balance scheduling tool with applications at a 1.9 cm amount for the entire season; 2) irrigation scheduled with tensiometers at an optimum application amount of 1.9 cm (100%) for the entire season; 3) managed using the treatment #2 to trigger irrigation but with an application of 1.1 cm until mid-bloom and 1.9 cm following mid-bloom (PA); 4) irrigation triggered using #2 but with 1.1 cm application amount for the entire season (DI); and 5) a rainfed control. Irrigation in treatments 2, 3, and 4 are being triggered when tensiometers reach 25-35 kPa in the optimum irrigation treatment (100%) using tensiometers placed at 30 cm. Irrigation scheduling was made to the 2015 PeanutFARM model and this adjusted model was used for irrigation scheduling in 2016. These calibrations were determined by adjusting the Kc values and durations (Figure 3) to simulate the models irrigation recommendation to the 2015 soil tension based irrigation scheduling.

Irrigation Treatments:
Overall, the 2016 growing season has been relatively dry with only 3.0 cm of rainfall occurring in the month of July (Figure 4). A total of ten irrigation treatments were applied using the soil tension irrigation scheduling and nine irrigation treatments were applied using the PF model. Of the ten irrigation treatments scheduled, three of them were applied prior to mid-bloom.

Field Measurements:
Volumetric water content has been recorded weekly since initiating irrigation treatments at depths of 10, 20, 30, 40, 60, and 100 cm using a Profiler Probe (Delta-T Devices Ltd, Cambridge, UK).

Maturity has been assessed by pod blasting and determined by the percentage of pods which are characterized by a brown/black pod exocarp. Mechanical digging of the two center rows of each plot occurred for the Valencia genotypes on 18 August. Plants were allowed to dry in the field and pods were separated from the peanut vines using a hand thrasher on 22 August. Peanut pods were then dried to approximately 10.5% water content. Valencia peanut genotypes yield the greatest in both the PeanutFARM (PF) and 100% irrigation
treatment (Figure 5). No statistical differences in pod yield were observed between the PF and 100% irrigation treatment. The runner type peanut genotypes will be harvested on 19 September. Following the harvest and processing of all peanut genotypes, peanut pod grades will be quantified by determining total sound mature kernels (TSMK).

2016 \( K_c \) Curve

![2016 Kc Curve](image)

Cumulative aGDD's

**Figure 3:** The 2016 PeanutFARM irrigation model crop coefficient curve (Abbreviations: aGDD, adjusted growing degree days).

2016 Rainfall

![2016 Rainfall](image)

Cumulative Rainfall (in)

Date (days)

**Figure 4:** The 2016 cumulative rainfall. Arrows on the figure represent when a PeanutFARM scheduled Irrigation treatment was applied.
Figure 5: The 2016 valencia pod yields (Abbreviations: DI, Deficit; PA, primed acclimation; LSD, Fischer’s protected least significant difference).

Project 2: Live Oak

Design
The experimental design included four replicate plots for each treatment. A total of 60 plots per crop (5 irrigation treatments x 3 fertility levels x 4 replicates) were monitored. Peanut was planted on 19 May, 2015.

Treatment structure
1. 5 irrigation treatments
   a. I1 (Rationale): irrigation mimicked peanut grower’s irrigation practices.
   b. I2 (PeanutFARM): irrigation was determined using the PeanutFARM app. As part of the inputs, rainfall data was obtained from the FAWN weather station located in Live Oak, FL.
   c. I3 (SMS): using the SENTEK probes, moisture content of the soil was monitored and irrigation was determined using the maximum allowable depletion (MAD) and field capacity (FC) points to refill the soil profile with irrigation accordingly.
   d. I4 (60% I1 Reduced): it corresponded to the 60% irrigation of I1 (60% of peanut grower’s irrigation practices). This represented a low irrigation treatment.
   e. I5 (NO): non-irrigated plots.

Field Management
On 15 March, the peanut field was harrowed and again on 11 May 2016 a few days before planting. No plowing was performed due to potential damage to lysimeter hoses. Peanut (Georgia 06G) was planted on 13 May 2016 at a row spacing of 30" and 5-6 seed/ft. for a total plant population approximately 90,000 seed/acre.
At planting, a fungicide and an inoculant (i.e. Macho + Lift Inoculant) were applied through the planter directly in the furrow. A 500 lb/ac granular application of 3-7-28 was performed at 42 DAP and a gypsum application of 2000 lb/ac (i.e. GypsumMax) was performed at 41 DAP. Both products were broadcast with a Tag-Along spreader.

At harvest, Maturity level tests utilizing the hull scrape and profile board were performed to determine the harvest time. Digging was performed on 30 September 2016 at 140 after planting (DAP). Peanuts were dug using a digger KMC 236 DSI converted to 230 DSI. Peanuts were dried four days before harvest. Pods were harvested on 4 October 2016 using a KMC 3300 peanut combine. Yield determination was performed on the 7th and the 8th planting rows starting ten feet inside each plot to avoid border effects. A total length of 20 feet in each row were harvested for data analysis. The parameters measured per plot were: peanut weight and percentage of moisture (wet basis). All samples were taken to a drying facility located in PSREU, near Citra, FL. When average moisture reached 10.5%, the samples were removed from the driers and moisture content was taken (dry basis) on each sample.

The peanut growing season covered from 13 May to 30 September 2016 (planting and digging dates, respectively). During the crop season, cumulative rainfall and calculated ET, summed up to 25.9 and 22.4 inches, respectively. A flat irrigation rate of 0.5” and 0.7” were applied across all plots the day before planting and on 15 May to apply herbicide. Irrigation treatments started on 1 June (19 DAP). Cumulative irrigation applied per treatment was: 21.7, 8.4, 8.1, 13.2 and 1.2 inches for I1, I2, I3, I4 and I5, respectively. Therefore, irrigation treatments applied about 61%, 63%, 39% and 94% less water than I1, which is intended to simulate peanut grower’s irrigation practices. For the initial stages of the crop (May-July), monthly average rainfall was 13%, 58% and 45% below the historical average (Cum average May-July: 8.06” rainfall). And by contrast, excessive rainfall events occurred in August (monthly average 12.4”) and September (5.52”) resulting in a cumulative monthly average 49% and 9% above historical average (7” and 3.5”, respectively). Due to the low water holding capacity characteristic of sandy soils, most of the rainfall was not used by the crop and thus, it was lost through drainage. VWC was evaluated at: I1, I3 and I5 irrigation treatments in the peanut experimental field. VWC ranges obtained at I1, I3 and I5 were: 0.05-0.11 in³/in³, 0.03-0.11 in³/in³ and 0.03-0.11 in³/in³, respectively. Similar VWC trends were found at each irrigation treatment across the year. VWC in I1 was higher in all soil layers throughout the season compared to the I3 and I5 VWC soil layers. However, I1 applied 43% and 95% more irrigation than I3 and I5, respectively. The first soil sampling in the peanut season was performed on May 11 (pre-planting); however, irrigation was not applied until May 12, to provide well-moisture conditions for planting. Hence, all treatments show low VWC during this sampling date. I1 kept constant high VWC across all peanut season averaging 0.09 in³/in³ (Figure 14). The I3 treatment fell below FC of the deepest layers during three sampling dates (20 June, 6 July and 25 July, Figure 15). However, after 20 June, VWC in I3 quickly increased in most of the soil layers. I5 prevailed below FC from 6 July until 19 September mostly on the deepest soil layers (Figure 16). Heavy rainfall events occurred on 8, 11 and 14 August (Cum. rainfall = 8.27”), helping increase moisture in all treatments, but especially in I5 treatment; however, most of that rainfall was ineffective for crop uptake and it was lost through leaching.

Final peanut yield means per irrigation treatment were: 7,201, 6,656, 6,695, 7,117, and 4,577 lb/ac for I1 through 5, respectively. I5 was significantly lower than the other four irrigation treatments (Figure 6).
Figure 6. Average peanut yield data across irrigation treatments. Data standardized for 10.5% moisture. Different letters indicate differences at the 95% CI for irrigation treatment means.

Presentations and Extension Articles


Leidner, J. Root work for drought tolerant genetics. In: Southeastern Peanut Farmer; 2016, Jan./Feb., Vol. 54.


