IRRIGATION

Irrigation is critical in peanut production because it allows us to take advantage of other inputs. Water is needed to move Ca from land plaster into the pegging zone and to keep soil Ca in solution and available to the pods.

Irrigation also improves the effectiveness of herbicides (e.g., Prowl, Sonalan, Dual, Valor, Cadre), soil fungicides and soil insecticide (Lorsban). Without timely rain or irrigation these inputs can be wasted. Irrigation lowers soil and canopy temperatures, which allows for normal peg development and greatly reduces aflatoxin risk. Irrigation also helps fungicides with white mold activity reach and protect tissues at or below the soil line.

Irrigation is also the best insect control available in that it makes the peanut plant much less susceptible to some of the most economically damaging pests: lesser cornstalk borer, burrower bugs, all foliage feeding worms and spider mites.

BASIC IRRIGATION SCHEDULING

The peanut growing season can be divided into five intervals based on the potential need for irrigation.

Timing	Rate	Significance
At-planting	0.5" if needed	Stand establishment. Pre-emergence herbicide infiltration/activity.
Emergence – 45 DAP (pegging)	0.5" if needed	Enhance post-emergence herbicide activity (e.g., Cadre).
45 – 60 DAP (pegging – early pod-fill)	0.75 – 1.0" per week (minus rain)	Land plaster infiltration and solution. Maintain pegging. Prevent lesser cornstalk borer damage.
60 – 110 DAP (pod-fill)	1.0 – 1.5" per week (minus rain)	Fill pods. Peak water use occurs at about 75 DAP. Keep calcium in soil solution. Move fungicides into the soil. Suppress corn earworm, spider mites, and some soil insects (lesser cornstalk borers, burrower bugs).
110 – 125 DAP	0.75 – 1.0" as needed to prevent wilting	Avoid late season drought stress and prevent aflatoxin. Provide adequate soil moisture for digging.

Several better alternatives than the above rule-of-thumb method are available. The **Irrigator Pro** model (http://www.ars.usda.gov/services/software/download.htm?softwareid=204) bases irrigation decisions on soil moisture sensors. The **UGA EASY** (Evaporation-based Accumulator for Sprinkler-enhanced Yield) **Pan** Irrigation Scheduler allows crop water needs to be monitored in the field using a low cost system that can be built on farm after a trip to the hardware store (http://extension.uga.edu/publications/detail.cfm?number=B1201). A third irrigation scheduling option is **UF Peanut Farm**, which uses weather data and adjusted growing degree days to estimate crop canopy cover and daily water use (http://peanutfarm.org/).

SOIL MOISTURE SENSORS

Michael T. Plumblee, Precision Agriculture Extension Specialist

Soil moisture sensors are another alternative to the checkbook type scheduling methods listed above. Some of the benefits from using an irrigation schedule to know when to irrigate are to:

- Meet the crop water demand with supplemental irrigation at appropriate timings throughout the growing season;
- Reduce the likelihood of plant stress – yield is often lost by the time stress symptoms are seen;
- Reduce over-watering crops (includes unnecessary costs); and
- Maximize pod yield, quality, and profits.

Benefits of scheduling irrigation with soil moisture sensors relative to other methods are that they:

- Allow real-time site-specific monitoring of soil moisture,
- They can assist with determining water sensitive periods throughout the growing season by accurately depicting crop water use, and
- Sensors help quantify the actual amount of rainfall that enters the soil and into the rooting zone.

Soil moisture sensors are separarted into main categories based on how they read soil moisture. The first category, **volumetric sensors** (Volumetric water content and Capacitance sensors) measure the amount of water in a given volume of soil providing a soil water content percentage. The second category, **soil water tension** (Gypsum blocks and Watermark senosrs) measure the force that the plant roots must overcome to extract water from the surrounding soil particles. These sensors provide readings in units of kilopascals (kPa) or centibars (cbar). Several differences exist between the two categories of sensors including price, accuracy, recurring subscription costs and telemetry or how data is accessed; however, both categories are suitable for irrigation scheduling in row crops.

The following are recommendations on commonly asked questions with regard to soil moisture sensors.

How many sensors do I need? At least one sensor or set of sensors (if multiple sensors are needed for multiple depths) per irrigation management zone (i.e. under each center pivot) will aid in irrigation decision making. Other scenarios where more than one sensor per irrigation management zone may be warranted include changes in soil texture across the field in areas that can be managed separately or with the use of a variable rate irrigation system. Furthermore, if a particular system takes several days to make one revolution, consider placing sensors at the start and stop of the irrigation cycle to determine if the system needs to continue on to another irrigation cycle at completion of the prior cycle.

Where do I put my sensors within the field? Several factors should be considered when placing sensors in the field to ensure a representative reading will be obtained. Consider soil texture differences; try to manage irrigation based on the soil texture that represents the majority of the field. Avoid putting sensors in areas that are very droughty or hold water during the growing season. If yield data is available, yield maps can be used as another tool to evaluate areas of the field to avoid or try to stay in with placement. Try to place sensors in the field after planting and in areas where a representative stand exists. Avoid traffic rows and minimize damage to plants when installing sensors. Due to the limitations on irrigation sprinkler packages on center pivot systems avoid placing sensors near the center point of the system. It is recommended to try to install sensors a tower or two from the end of system to ensure irrigation uniformity.

Do I install sensors in the row or row middle? Install soil moisture sensors within the planted row of plants. By installing sensors within the row accurate measurements of soil moisture within the crops rooting zone can be achieved. With all soil moisture sensors sensor to soil contact is essential in order to accurately read soil moisture. Therefore, the correct installation of soil moisture sensors is critical to the sensors working correctly.

How do I know when to irrigate based on the soil moisture sensor? Most sensor manufactuerers have generic threshold values associated with the crop and soil texture that the sensor is being placed into. Typically, these threshold values reflect allowing the plant available water of a specific soil texture to deplete 25 to 50% before irrigation is applied to recharge. On-going research at Clemson University is evaluating sensor thresholds in multiple crops to develop sensor threshold recommendations based on South Carolina soil textures and crop.

If soil water tension, Watermark, type soil moisture sensors are being utilized to schedule irrigation, Clemson University has put together a simple web-based application that can be accessed via smartphone or computer to take actual sensor readings and assist with making irrigation decisions based on predefined or manually entered thresholds. The web-based app can be found online at:
https://precisionag.sites.clemson.edu/calculators/irrigation/watermarkcalculator or www.irrometer.com/thresh.html

EVAPOTRANSPIRATION

Jose Payero, Irrigation Specialist

Evapotranspiration is the combination of crop water loss from soil evaporation and water loss from the plant by transpiration. Years of research have shown crop yield tends to be linearly related to crop evapotranspiration (ETc), although the impact depends of crop growth stage. **Figure 1** shows the linear relationships between reduction in relative evapotranspiration and reduction in relative yield for peanuts for different growth stages (from FAO). The slope of the line (ky) indicates the sensitivity to water stress for each growth stage. **Fig. 1** suggests that peanut is less sensitive to water stress during the vegetative and ripening periods (ky=0.2). These two growing periods correspond to the beginning and end of the growing season when weather conditions are usually cooler and evapotranspiration demand is considerably reduced compared to the middle of the growing season. If rain is limited during the growing season, reducing or withholding irrigation during these two periods (early and late) would normally result in the least yield reduction. Sensitivity to water stress increases significantly during the yield formation period (ky=0.6), and stress during this period could normally result in reduced pod weight, depending on severity and duration of the stress period. The highest sensitivity to water stress occurs during the

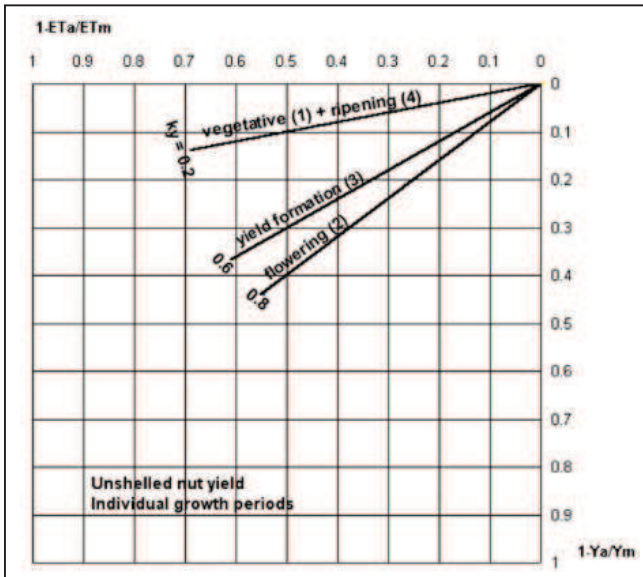

Fig. 1. Relationship between reduction in relative evapotranspiration (1-ETa/ETm) and reduction in relative yield (1-Ya/Ym) for peanut. ETa and ETm are actual and maximum crop evapotranspiration and Ya and Ym are actual and maximum yield.

flowering period (ky=0.8). Stress during flowering should be avoided if possible, since it could cause flower drop and could also reduce pollination, which could significantly reduce yield, depending on the severity and duration of stress. The average sensitivity for peanuts for the whole growing season is ky=0.7. In addition to using these ky values for irrigation timing, they can also be used to estimate crop yields from measured or calculated values of ETc.

To examine how much of an impact short periods of drought actually have on crop yields and how much of an impact could be expected by adopting irrigation, we could examine the impact of weather conditions on crop evapotranspiration, which as indicated above would have a direct impact on crop yield. As an example, we calculated the daily and cumulative evapotranspiration (ETc) under irrigated (Potential) and non-irrigated (Actual) conditions for peanuts in Barnwell County based on daily weather and rain data for the last 10 years (2009 to 2019) (**Figure 2**). This shows that, on average over the last decade, crop evapotranspiration (and therefore yield) for the dryland peanuts crop has been significantly reduced compared to the irrigated crop. The average seasonal peanuts ETc under irrigation at this location was around 22 inches, compared to 14 inches under dryland. This is a reduction in crop ETc of around 8 inches, or 36%.

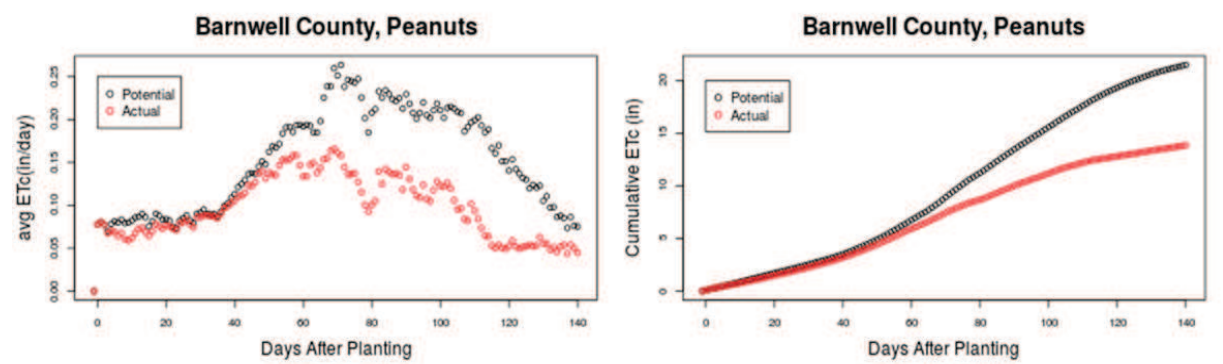

Fig. 2. Daily and cumulative crop evapotranspiration (ETc) for peanuts in Barnwell County under irrigated (Potential) and non-irrigated (Actual) conditions**.**

Similarly, **Figure 3** shows the calculated potential crop evapotranspiration (ET) (irrigated), actual crop ET (non-irrigated), and ET fraction (Actual/Potential) for peanuts in Barnwell County for each year during 2009 to 2019. It shows that during this period, rain was only enough to meet around 64% of the evapotranspiration needs of the crop.

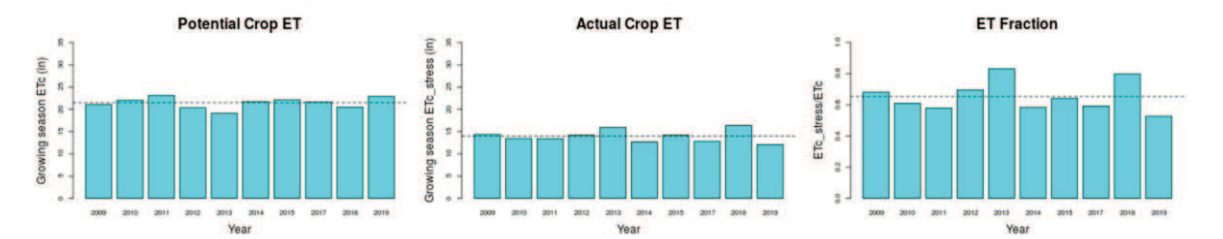

Fig. 3. Calculated potential crop evapotranspiration (ET) (irrigated), actual crop ET (non-irrigated), and ET fraction (Actual/Potential) for peanuts in Barnwell County for each year during 2009 to 2019**.**

A comparison of potential net returns of irrigated and non-irrigated peanuts was reported in the UGA peanut production guide quick reference using a yield gap of 1,300 lbs/acre between irrigated and dryland peanuts (http://gapeanuts.com/growerinfo/2018_ugapeanutguide.pdf). With this yield gap, Dr. Wesley Porter reported a Net Return Above Variable Cost (excluding land and management) of $221/acre and $63/acre for the irrigated and dryland crop, respectively. This is a difference of $158/acre or an increase of 71.5% in net returns with irrigation compared to dryland. They also reported a positive Net Return Above Variable Cost (excluding management) of $17/acre for the irrigated peanuts and a negative return (-$18/acre) for the dryland crop.