Benchmarking the Peanut Crop Coefficient Curve Using Remote Sensing

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Project Summary:

The SmartIrrigation CropFit App (SI CropFit) (https://smartirrigationapps.org/cropfit-app/) is a recently released irrigation scheduling tool that operates on a smartphone platform. It includes irrigation scheduling models for corn, cotton, peanut, and soybean. Based on evaluations conducted at Auburn, Mississippi State, the University of Florida, UGA, and the National Peanut Research Lab (NPRL), scheduling irrigation with the SI CropFit results in water savings of up to 40% and yield increases of up to 15% when compared to the traditional Extension Checkbook method and performs at least as well as scheduling irrigation with soil moisture sensors. The peanut model in SI CropFit predicts irrigation requirements for a generic, well-managed peanut crop. This project improves the peanut model by using remote sensing to quantify the growth stage of the crop in individual peanut fields and adjust irrigation requirements to match the field biomass observed with satellite-derived NDVI maps. These capabilities will be incorporated into SI CropFit and automatically applied when a peanut grower uses SI CropFit to schedule irrigation.

Working with the UGA Water Extension team and UGA county agents, 30 well-managed irrigated growers' peanut fields from 2023 and 2024 were identified across the Coastal Plain peanut growing area of Georgia (Figure 1). It was important for these fields to be well-managed to match the generic Kc curve included in SI CropFit. For each of these fields, SI CropFit was used to calculate a daily Kc. Weekly Planetscope and Sentinel-2 satellite images were used to calculate NDVI. Several approaches were evaluated to develop the empirical relationship between Kc and NDVI including simple linear regression, multiple linear regression, and machine learning models such as Random Forest. In these evaluations, the generic Kc curve included in SI CropFit (Figure 2) was compared to Kc developed from NDVI using the three different approaches. Overall, the Random Forest approach performed the best for predicting Kc from NDVI over the entire growing season, but this approach is too complicated to be incorporated into SI CropFit. Ultimately, the decision was made to apply the NDVI Kc correction only to the rising slope of the Kc curve (Figure 2) as once the canopy closes, the generic curve included in SI CropFit accurately reflects crop water needs. Using the data from the 30 fields, an early season linear regression between Kc and NDVI was developed. Figure 3 shows the results of the early season linear regression developed with the data derived from one of the fields. The regression was developed using GDD-dependent Kc predicted by SI CropFit and the corresponding NDVI for that date. NDVI was calculated using Planetscope images to maximize the data points available as this platform provides daily images. The decision was made to apply the regression equation beginning with 30 days after planting to ensure quality NDVI images. When plants are small, bare soil dominates the image and NDVI values can be misleading. Figure 4 shows the difference between Kc predicted by SI CropFit and the regression equation for the same field shown in Figure 3.

Work is continuing on this project. All available growing season Sentinel-2 and Planetscope satellite images for the 30 fields have been extracted and NDVI values tabulated. All the tabulated values will be used to develop a more robust regression equation which will be evaluated against the SI CropFit of all 30 fields. The regression equation will be evaluated in grower fields during the 2025 growing season.

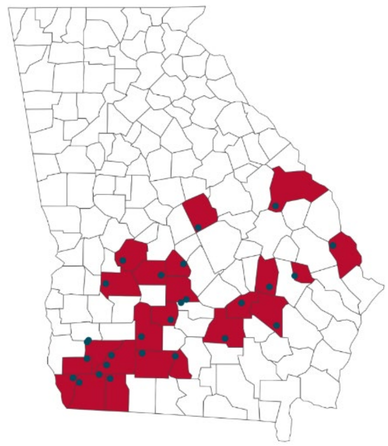

Figure 1. Georgia counties which contained the 30 grower fields from 2023 and 2024 used in the study.

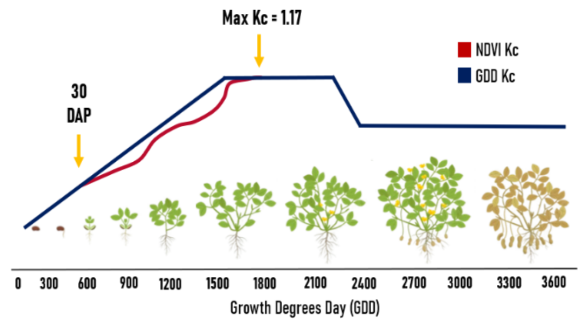

Figure 2. The GDD-based Kc curve is currently used in SI CropFit. The NDVI Kc curve shows how the regression equation was applied to customize the GDD-based Kc curve for individual fields. The NDVI-based correction was applied beginning at 30 DAP and until Kc=1.1.

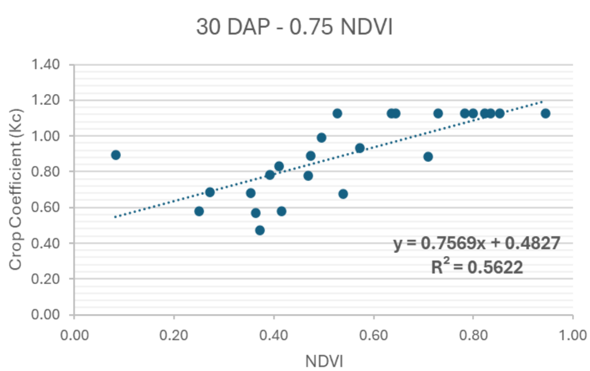

Figure 3. The early season linear regression equation developed with the NDVI data derived from one of the 30 project fields. The equation was developed using GDD-dependent Kc predicted by SI CropFit and the corresponding NDVI for that date.

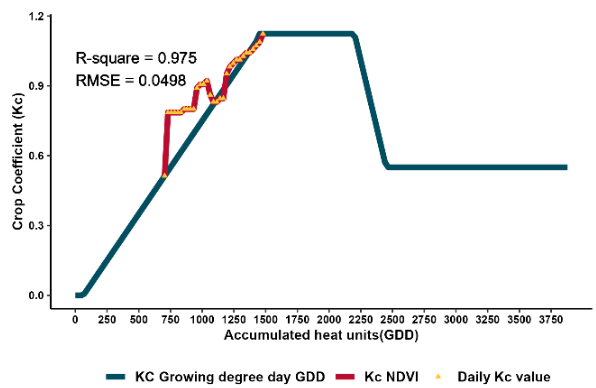

Figure 4. Comparison of the difference between Kc predicted by SI CropFit and the regression equation for the field shown in Figure 3. The graphs shows that the canopy in this field was developing more slowly than predicted by the SI CropFit Kc curve. Using the SI CropFit curve to schedule irrigation in this field, would likely have resulted in applying less irrigation water than was needed early in the season. Triangles indicate days on which NDVI images were available.