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Title: Using Active Spectro-radiometers to Guide Fungicide Applications in Peanut

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Locations: UF-WFREC, Jay, FL
UF-PSREC, Citra, FL

Abstract/Project Summary:

Fungicide applications are an important and costly crop input for managing disease and maximizing yield for peanut. Variable rate technology and spectral measurements of plant canopies could be employed to reduce input cost related to disease control for peanut. Yet, the ability of active spectro-radiometers to detect changes in plant canopy in response to disease for peanut is uncertain. Replicated field studies were installed at two locations in Florida to evaluate spectral measurements of peanut plant canopies in response to increasing levels (0, 1, 5, 15, 30, 45, 60 % of row inoculated) of white mold disease using the GreenSeeker for measurement of canopy NDVI. Visual assessment was used to confirm contrasting levels of infection across treatments. Treatments did result in infection and levels of infection increased as the season progressed. However, no differences in infection levels across treatments were detected. Time of day did not influence NDVI readings from the active sensor. Yet, variation in disease levels provided an opportunity for the NDVI sensor to detect possible changes in canopy properties. No differences in NDVI values were observed in relation to increasing levels of disease presence until later in the growing season. At this point, fungicide treatments would be ineffective precluding the use of this technology for delineating treatment areas.

Project Description:

The objective of this project was to identify spectro-radiometers capable of accurately detecting disease induced changes in spectral measurements of plant canopies for the purpose of developing variable rate fungicide programs in peanut. An active sensor was evaluated under a variety of environmental conditions to the potential for commercial use. The treatments were designed to test the sensitivity of the sensor to changes in spectral canopy measurements in response to increasing disease pressure under various environmental conditions.

Hypothesis: Active spectro-radiometers can accurately detect changes in plant canopy reflectance in response to various levels of disease intensity.

Objective 1. Relate spectral measurements of plant canopies to visual white mold (Scerotium rolfsii) disease ratings for peanut at Jay and Citra Florida.

Rationale:

Fungicide programs are a significant and necessary expense to maximize peanut production in the southeast U.S. Site-specific management and remote sensing technologies could offer strategies for reducing input cost related to disease control. Previous studies have evaluated the use of passive multispectral sensors to assess disease severity in peanut. Passive sensors require that measurements be made under uniform weather and light conditions, limiting measurement to certain times of the day. In contrast, active sensors provide their own light source making measurements possible under a wide range of weather and light conditions. Research is needed to determine the potential for active sensors to detect plants affected by disease under a wide range of light and weather conditions. The goal will be to develop technology capable of quickly and accurately delineating zones within a field that require fungicide treatment.

A major challenge for precision applications is to identify instruments capable of timely detection of disease to enable treatment before significant yield reduction occurs. Timely disease detection will require instruments that are very sensitive to changes in canopy measurements that correspond with the targeted disease. Research is needed to determine the sensitivity of spectro-radiometers to disease-induced changes in plant canopy measurements.

Methods:

Objective 1. Peanuts (variety Georgia 06G) that are susceptible to white mold was planted during May and maintained according to standard production practices with the exception of fungicide applications. Plots were 4 rows wide and 20 ft long with treatment rows on one of the center two rows. Contrasting white mold infection levels were imposed on the treatment row by inoculating increasing lengths of row (1, 3, 6, 9, 12 ft) compared to an untreated check. This created treatments were 0, 1, 5, 15, 30, and 60% of the total row length was inoculated. To insure only white mold infections occured, peanuts were treated with routine applications of chlorothalonil starting at 30 d after planting and repeated every 14 d. Weekly measurements of disease ratings were made starting at 30 d after planting using subjective visual assessments (hits per 2 ft method) and quantitative spectral measurements using GreenSeeker. Spectral measurements were made three times throughout the day. Visual assessments were used to develop disease severity curves for contrasting treatments and to compare to sensor measurements.

Objective 2. Peanuts were inoculated at a single point in the center of the plot and grown according to IFAS protocols including sprays of chlorothalonil. Spectral measurements of plots were made weekly as described for objective 1. Fungicide applications were made to increasing row lengths away from the point of inoculation (0, 3, 6, and 9 ft in both directions from the inoculation point).

Results:

Peanuts were inoculated at cracking according to treatment protocols. Visual assessment of white mold infection ratings was made weekly following inoculation. Ratings were collected as the number of hits per 2 ft for 6-3 ft sections of the treatment row. The number of hits was summed for each plot to determine the total number of hits per plot. The average number of hits overall increased as the growing season progressed except during the first two weeks of September when hits declined and then increased by the end of the month (Figure 1). Treatments averaged 7.6 total hits on August 7 and 10.5 on September 24. While differences in treatments did exist, no clear trend across treatments was detected. However, variation in disease severity was sufficient to allow for evaluation of the spectral technology.

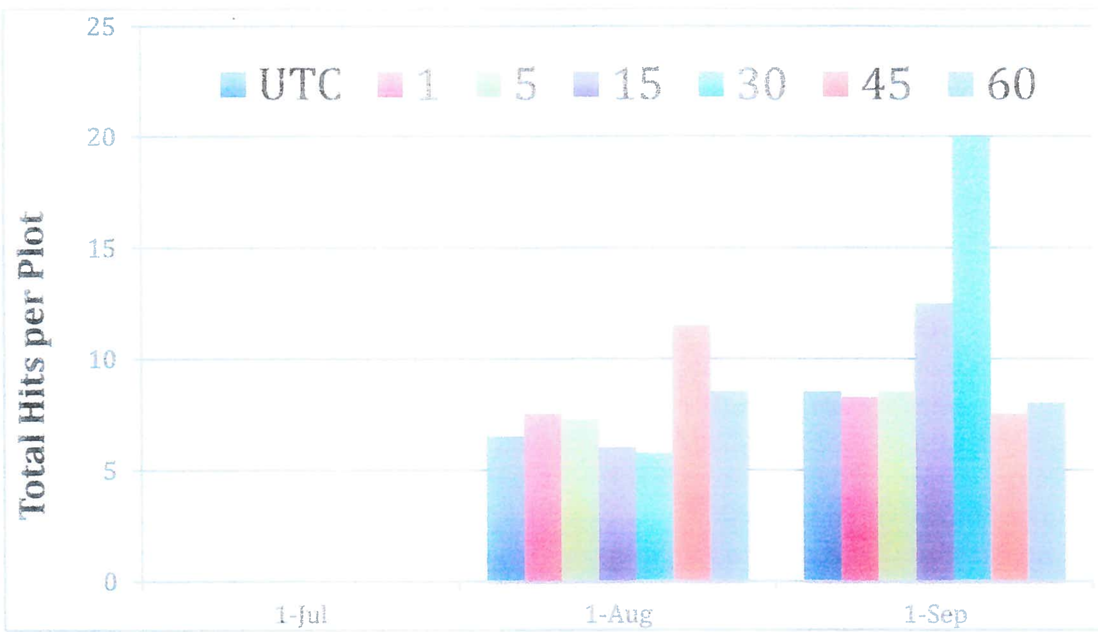

Figure 1.

Plots were scanned weekly at Jay and Citra starting about 30 days after planting. NDVI readings generally increased until mid June when maximum canopy was reached. NDVI readings leveled off around 0.90 during mid June and declined slightly just before harvest Figure 2). Considering the timing of canopy closure and stabilization of NDVI readings, reading made after August 2 were used to relate NDVI readings to white mold ratings.

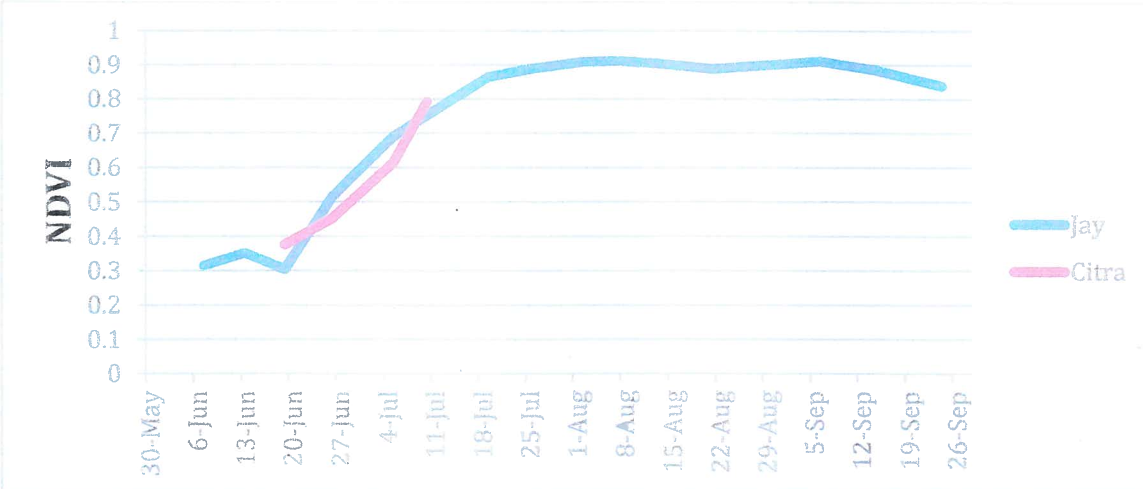

Figure 2

The progression of NDVI readings and white mold ratings for the Jay location is shown in figure 3. Reading were taken three times per day under various weather conditions and no differences were observed across time of day. Reading were averaged to evaluate sensor detection of white mold. Figure 3 shows that NDVI continued to increase as white mold ratings increased prior to canopy closure and stabilization of NDVI readings. With canopy characteristics dominating NDVI readings, detection of white mold during this growth period would be difficult.

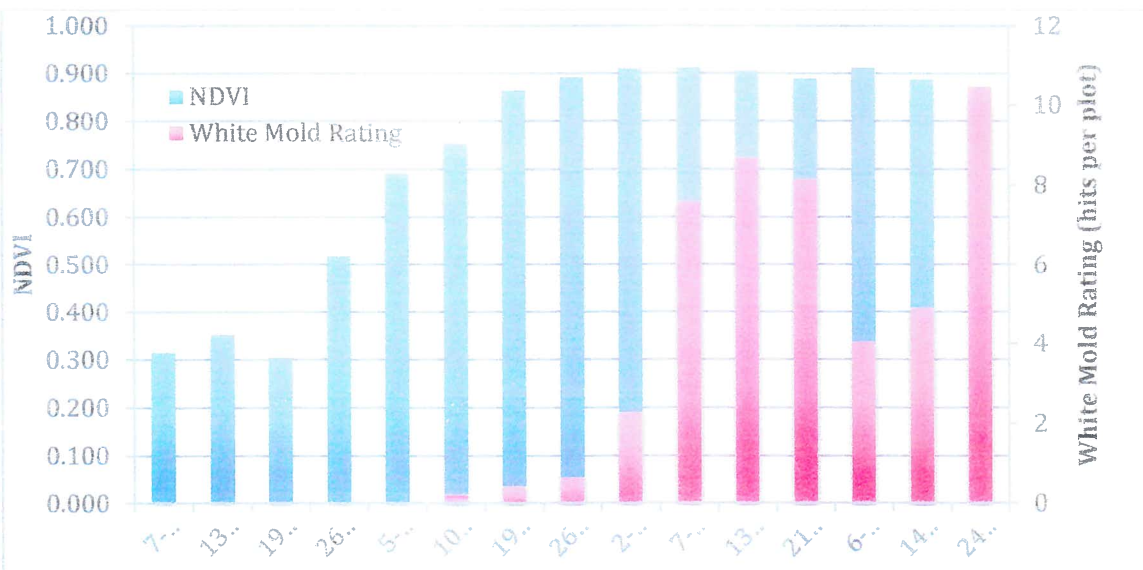

Figure 3

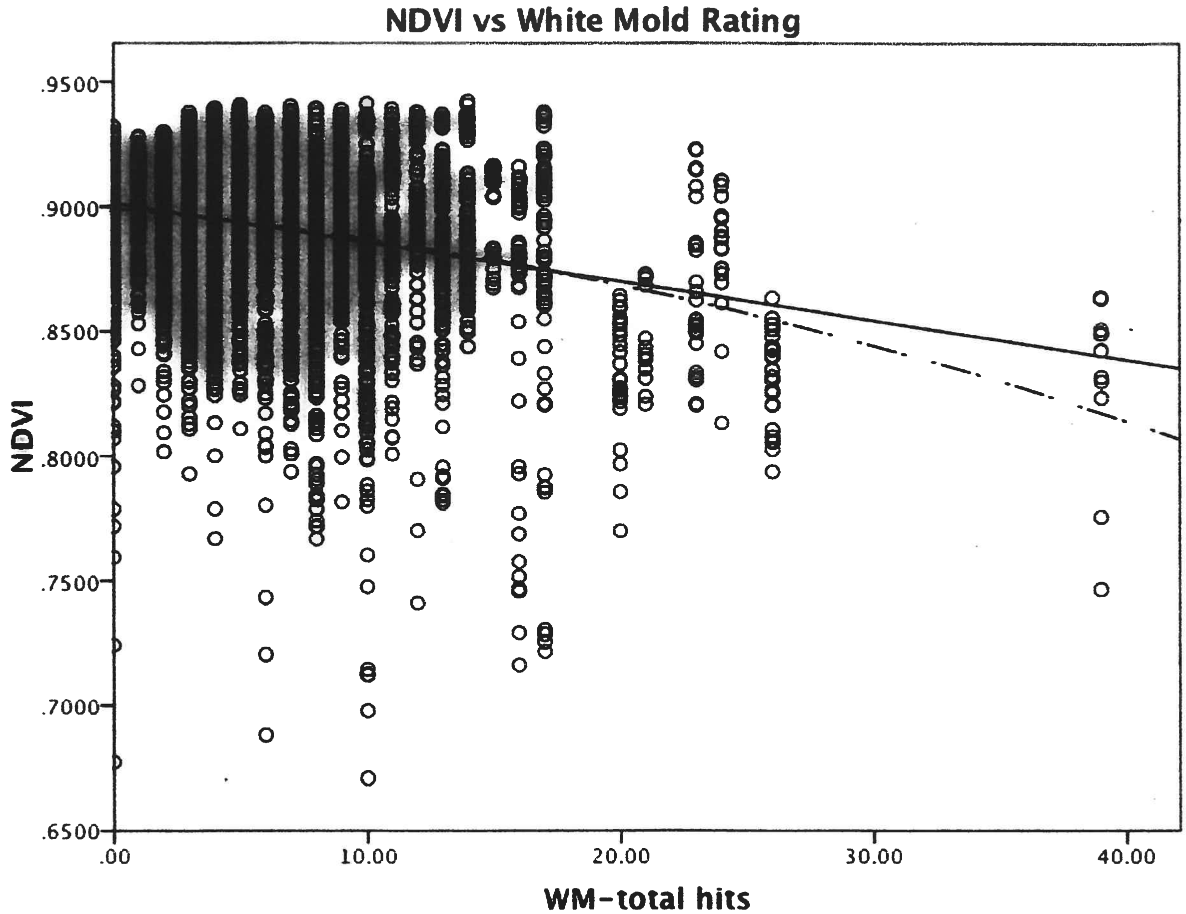

Figure 4

Following stabilization of NDVI values, variation in white mold ratings were sufficient to result in subtle changes in canopy appearance. During this period, detection of white mold with NDVI sensors could be possible. Figure 4 show there was a weak relationship between the number of white mold hits per plot and NDVI values. However, the hit count needed to exceed 20 hits per plot (18 ft) to result in significant reductions in NDVI readings. Fungicide application would likely need to occur prior to detection by NDVI sensors. This suggests NDVI sensors are not sensitive to subtle changes in canopy appearance due to pathogens that impact basal regions of peanuts.

Conclusions:

Peanut growth and development and changes in canopy structure throughout the growing season will influence NDVI readings. Time of day did not influence readings from the active NDVI sensor. Infection of peanut by white mold does not result in significant changes to canopy properties detectable by NDVI sensors. At the point were NDVI sensors may detect changes in the canopy properties, significant levels of infection have occurred which will reduce the effectiveness of fungicide treatments.