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Southeastern Peanut Research Initiative 2012
FINAL REPORT

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Project Title: Validation of a weather-based decision support system (DSS) for the management of white mold (Sclerotium rolfsii) in peanut.

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1. Abstract

Decision support systems (DSS) are frequently used by extension agents, crop consultants, growers and other agricultural clientele to provide accurate and timely management of plant diseases. Currently, the main DSS for peanut growers is the Peanut Rx disease risk index. Peanut Rx is an excellent pre-plant DSS tool, however, it does not include the site-specific weather conditions growers experience in their fields each year. Management programs may need to be adjusted to account for disease development related to the unique environments created from these weather conditions. In the Virginia-Carolina peanut production areas, researchers observed that the efficiency of prescription fungicide spray programs could be increased by combining them with the Phipps-Langston risk algorithm and a regression model developed by Smith et al. (Plant Disease, 2007. 91:1436-1444). Thus, it is hypothesized that by integrating Peanut Rx with weather-based models producers will have more robust information available to determine the best management practices (i.e. fungicide spray selection & timing) for their peanut fields.

2. Objectives

The objectives of this study were assess the effects of temperature on the mycelia growth of *S. rofsii* and evaluate the efficacy of previously developed the ratio model in the field.

3. Methods

Twenty-three isolates of S. rolfsii collected from peanut and tomato fields in the Florida counties of Jackson, Gadsden, Hamilton, Alachua, Levy, Marion, Hillsborough and Manatee were used for the temperature response assay. Select isolates from each grouping were exposed to different temperature conditions in-vitro to determine the range of environmental conditions conducive to fungal development. Mycelia plugs of each isolates were transferred to petri plates and exposed to 15 different temperature treatments as seen in Figure 1 below. The temperature treatments consisted of mean temperatures of 15, 20, 25, 30, and 35°C that had twelve hour oscillations of ± 0, 4 and 8°C (Figure 2). The diameter of fungal mycelial growth was measured once every 12, 24, 36 and 48 hours after inoculation on the media plate. The test was replicated 4 times with the growth chambers representing the experimental units.

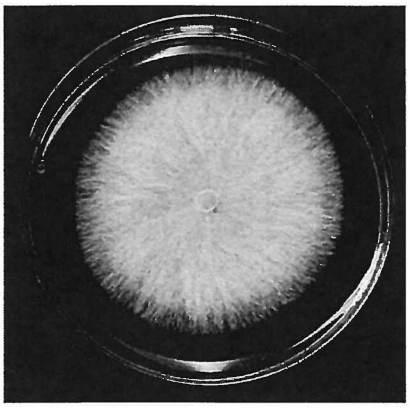


Figure 1. An example of an inoculated plate with *Sclerotium rolfsii* isolate LE948 after 48 hours under 30°C constant temperature (APDA 100 x 15 mm plate).

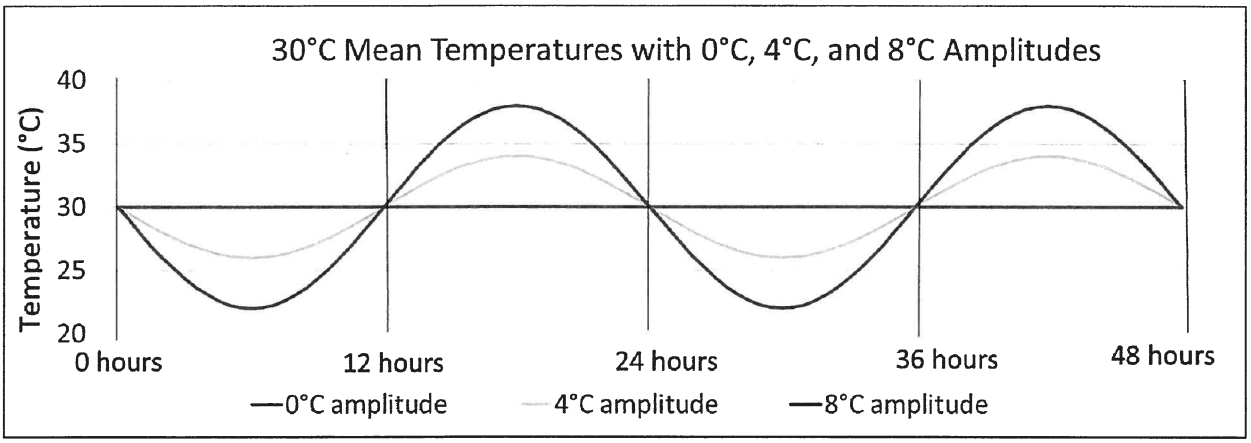


Figure 2. An example of the oscillating temperature treatments for the mean temperature of 30°C across the amplitudes of 0, 4 and 8°C for a duration of 48 hours.

Peanut experimental plots were planted at the University of Florida's Plant Science Research and Education Unit (PSREU) in Citra, FL and the North Florida Research and Education center in Quincy and Marianna, FL on 30 April 2014 and 5 June 2014. The variety Georgia-06G was used in this study and planted at a density of six seeds per foot of row on 36-in. row centers. Plots consisted of paired 25-ft long treatment rows with untreated buffer rows between each treatment arranged in a split-plot design with 4 replications (0.77 A). Fungicide applications were made throughout the season following the schedule outlined in table 1. Foliar treatments were applied with a CO_2 backpack sprayer calibrated to deliver 25 gal/A at 30 psi with TeeJetXR 8004VF nozzles at 36-in. spacing. Research plots at the PSREU were inoculated with *S. rolfsii* infected grain 2 weeks after planting. Fungicides treatments began based on the white mold risk model or 30 days after planting as indicated in table 1 below.

Percent disease incidence was estimated by recording the presence of white mycelia in 1-ft sections of the canopy. This values were recorded as hits with the maximum number of hits possible being 50. Yields were obtained by weighing harvested peanuts from the two treatment rows on a scale. All data was analyzed with ANOVA using SAS version 9.2 and differences were determined using the multiple comparison test Fisher's least significant difference (LSD; $P < 0.05$).

Table 1. Spray schedule for fungicide treatments in the field trials at the three different sites listed in the methods above.. Numbers in the top row indicate the day after planting (DAP) when the product below was applied to the plots.

Treatment ID	#	20 DAP Banded	30 DAP Leaf Spot	40 DAP	45 DAP Leaf Spot	60 DAP Stem Rot	75 DAP Leaf Spot	90 DAP Stem Rot/Limb Rot	105 DAP Leaf Spot	120 DAP Leaf Spot
Untreated	1									
Leaf Spot	2		Echo 720 @ 1.5 pt/a		Echo 720 @ 1.5 pt/a	Echo 720 @ 1.5 pt/a	Echo 720 @ 1.5 pt/a	Echo 720 @ 1.5 pt/a	Echo 720 @ 1.5 pt/a	Echo 720 @ 1.5 pt/a
Tebuconazole	3		Echo 720 @ 1.5 pt/a		Echo 720 @ 1.5 pt/a	TebuStar @ 7.2 fl oz/a + Echo 720 1 pt/a	TebuStar @ 7.2 fl oz/a + Echo 720 1 pt/a	Abound 2.08SC @ 18 fl oz/a + Echo 720 1 pt/a	TebuStar @ 7.2 fl oz/a + Echo 720 1 pt/a	Echo 720 @ 1.5 pt/a
Provost	4		Echo 720 @ 1.5 pt/a		Echo 720 @ 1.5 pt/a	Provost 433 SC 8 fl oz/a	Provost 433 SC 8 fl oz/a	Convoy @ 13 oz/a + Headline @ 6 fl oz/a	Provost 433 SC 8 fl oz/a	Echo 720 @ 1.5 pt/a
Teb. Model[a]	5	Model Dependent TebuStar @ 7.2 fl oz/a + Echo 720 1 pt/a				TebuStar @ 7.2 fl oz/a + Echo 720 1 pt/a	Echo 720 @ 1.5 pt/a	Abound 2.08SC @ 18 fl oz/a + Echo 720 1 pt/a	TebuStar @ 7.2 fl oz/a + Echo 720 1 pt/a	Echo 720 @ 1.5 pt/a
Proline Model[b]	6	Model Dependent Proline SC 5.7 fl oz/a				Provost 433 SC 8 fl oz/a	Provost 433 SC 8 fl oz/a	Convoy @ 13 oz/a + Headline @ 6 fl oz/a	Provost 433 SC 8 fl oz/a	Echo 720 @ 1.5 pt/a
Proline Early	7			Proline SC 5.7 fl oz/a		Provost 433 SC 8 fl oz/a	Provost 433 SC 8 fl oz/a	Convoy @ 13 oz/a + Headline @ 6 fl oz/a	Provost 433 SC 8 fl oz/a	Echo 720 @ 1.5 pt/a
Teb. Early	8		TebuStar @ 7.2 fl oz/a + Echo 720 1 pt/a		Echo 720 @ 1.5 pt/a	TebuStar @ 7.2 fl oz/a + Echo 720 1 pt/a	Echo 720 @ 1.5 pt/a	TebuStar @ 7.2 fl oz/a + Echo 720 1 pt/a	Echo 720 @ 1.5 pt/a	Echo 720 @ 1.5 pt/a

[a] In the early planting (before May 1st) sprays occurred at 40, 40, 40 DAP for Citra, Marianna and Quincy, respectively. Late planting (after June 1st) had sprays applied at 20, 30, 30 DAP for Citra, Marianna and Quincy, respectively.

[b] In the early planting (before May 1st) sprays occurred at 40, 40, 40 DAP for Citra, Marianna and Quincy, respectively. Late planting (after June 1st) had sprays applied at 20, 30, 30 DAP for Citra, Marianna and Quincy, respectively.

4. Results

Temperature effects on mycelium development.

The mean optimum temperatures for the 0 and 4°C amplitudes was the same for all isolates (Figs. 1 & 2). Overall, the mean optimum temperature for the 8°C amplitude was not significantly different between the 25 and 30°C treatments (Fig. 1). Individual comparisons indicated that 8 isolates have significantly lower mean temperatures than the other 15 isolates examined in this study (Fig. 2). No differences were noticed at 15 and 20°C mean temperature treatments and only minor shifts were observed at 35°C in the mean growth of the colonies.

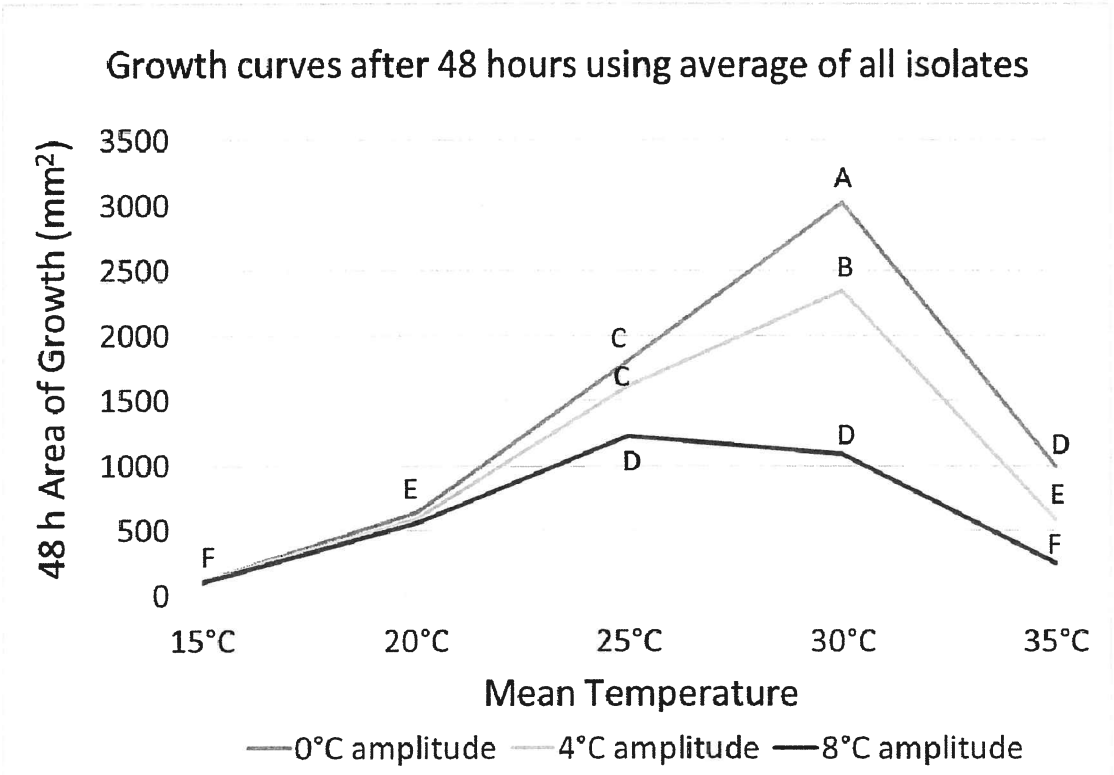
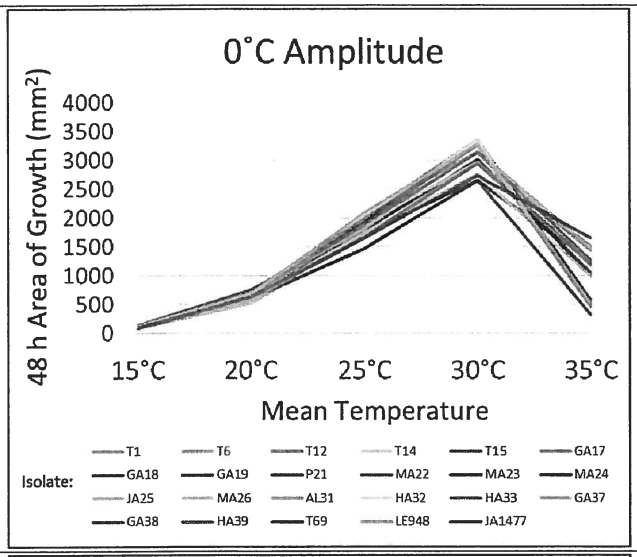
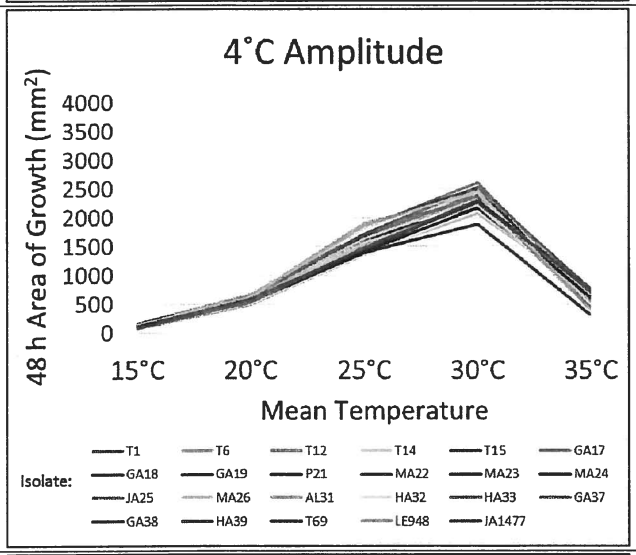


Figure 3: *S. rofsii* mycelial growth responses to mean temperatures and amplitudes listed. The area of mycelia growth was calculated from the mean diameter measurement recorded after 48 hours of expose to the temperature treatment. Letters above the sample points represent Fisher's least significant difference results, with those points with different letters being significantly different ($p < 0.05$).





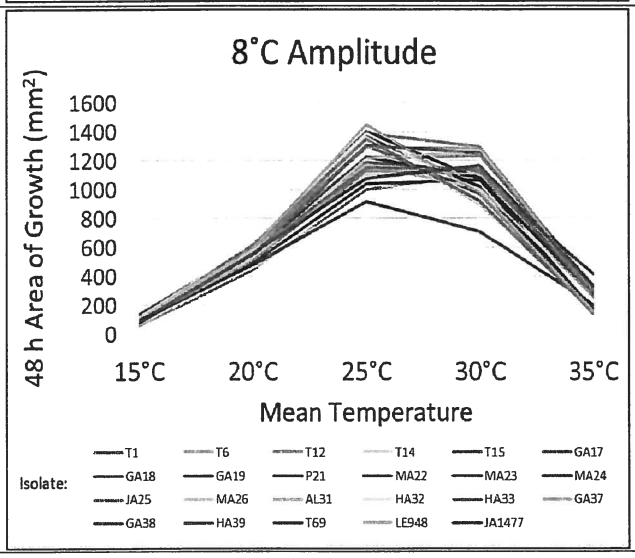


Figure 4: Line graphs of the 23 *S. rolfsii* isolates, indicated by line color, response to the various mean temperatures and amplitudes after 48 hours of growth. Area of growth was estimated from mean diameter measurements of the colonies radial growth.

Planting date effect on white mold development.
Both the Quincy and Marianna trials were not inoculated with white mold in 2014, and reduced numbers of white mold symptoms and signs were observed at these sites (Fig. 5). The plots at Citra, FL were inoculated with *S. rolfsii* infested grain and a substantial (5 fold) reduction in stem rot was observed between the two planting dates (Fig. 5).

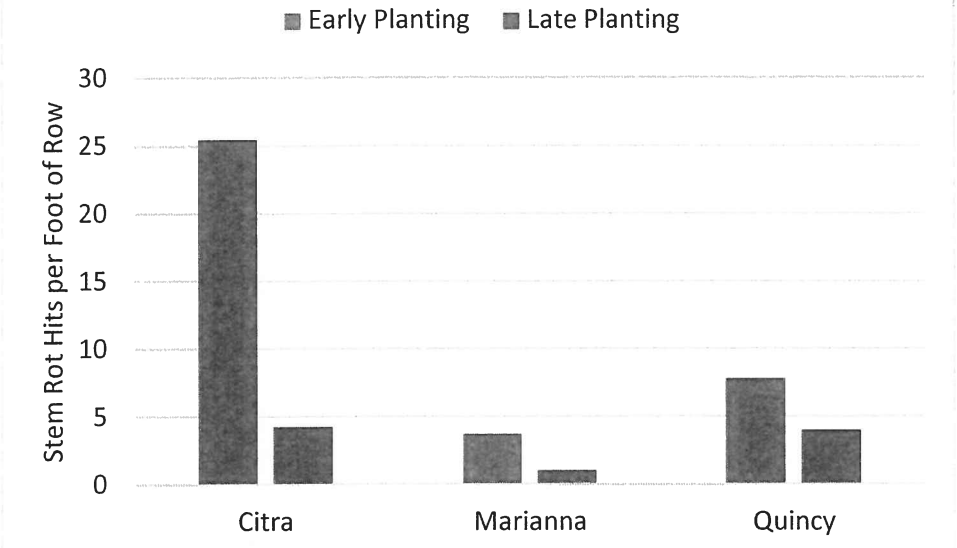


Figure 5: Average number of *S. rolfsii* hits per 1 foot of row in the plots at the different tests within Florida recorded between 90 and 110 days after planting. Early plantings were done at or before April 30th and late plantings were done at or after June 5th. Both the Marianna and Quincy sites relied on natural inoculum and the Citra site was inoculated with *S. rolfsii* infested grains at cracking.

Field Trial Results:
Yield data was collected from research plots located in Citra, Quincy and Marianna, FL examining the effects of the treatments listed in Table 1 except for Marianna planting date 1 (before April 30th). All treatments produced significantly higher yields than the untreated check except for tebuconazole early and model treatments from Citra planting date 1. In 15 out of 20 treatments, model applications of the tebuconazole and Proline numerically increased yields by 13 to 781 lbs/A versus early and standard calendar based spray programs (Table 2). Early planting dates had higher incidence of white mold than later planting dates indicating the variation in disease intensity between the treatments (Fig. 5).

Table 2. Yield results from the different field sites for the different treatments listed in Table 1. Yield data is estimated lbs/A based on weights obtained from the small plots. A protected Fisher's least significant difference is provided at the bottom for a p-value of 0.05. Bolded values mark the numerically highest yields observed at each site.

Tretment ID	CPD1[a]	CPD2[b]	MPD2[c]	QPD1[d]	QPD2[e]
Provost	5129	4334	6405	2914	3830
Proline Early	5300	4792	6374	2311	4014
Proline Model	5463	4868	6418	2128	4113
Tebuconazole	**5884**	4708	6321	2849	**4177**
Teb. Early	4410	5285	6363	2377	3403
Teb. Model	4352	**5489**	**6797**	**3039**	4099
Leaf Spot	4975	4265	5690	2602	3761
Untreated	4171	1517	3007	817	1646
LSD (p < 0.05)	***680***	***864***	***936***	***975***	***723***

[a] Yield data for treatments listed in Table 1 from Citra, FL for peanuts planted before May 1st, 2014.
[b] Yield data for treatments listed in Table 1 from Citra, FL for peanuts planted after June 1st, 2014.
[c] Yield data for treatments listed in Table 1 from Marianna, FL for peanuts planted after June 1st, 2014.
[d] Yield data for treatments listed in Table 1 from Quincy, FL for peanuts planted before May 1st, 2014.
[e] Yield data for treatments listed in Table 1 from Quincy, FL for peanuts planted after June 1st, 2014.

5. Summary

The growth of *S. roflsii* mycelium was significantly affected by fluctuations in temperatures the oscillated around a mean. Even a temperature oscillation at 4 C caused about a 25% reduction in growth of the isolates tested. This indicates that in natural settings the development of this pathogen will be affected by diurnal temperature patterns and extreme weather events. Thus, assessing the amount of time in which the pathogen is exposed to optimal temperatures is critical to determining its development. The soil temperature ratio developed in previous studies attempts to assess these time variables and should provide a good assessment of pathogen mycelial development.

Field studies were conducted in 2014 to assess the value of the model in determining early season applications of fungicides for *S. rolfsii* control. In these studies, it was observed that the model performed as well or numerically better than the calendar based sprays in all but 5 treatments for both Proline and tebuconazole products. The mixing of diseases, especially leaf spot diseases, in the plots makes it difficult to assess the true effect of these fungicides on white mold development. However, the indication that early planted peanuts have a higher probability of seeing significant white mold hits could be useful in assessing the value of the model, as it utility will vary depending on planting date.

Overall, the results indicate the importance of understanding pathogen's population response to environmental conditions when assessing disease risk early in the season in order to determine the proper management inputs (i.e. fungicides). Many factors can affect disease intensity, and continued research to understand these affects is critical to obtaining optimal peanut yields. As new resistant and tolerant varieties are developed, researchers will need to determine disease inputs carefully and over multiple seasons. This study provides more information about *S. rolfsii* phenotypic traits and indicates that genotypic assessment of diversity is critical to understanding this pathogen more clearly.