

# The Wet Deposition of Soybean Rust Urediniospores

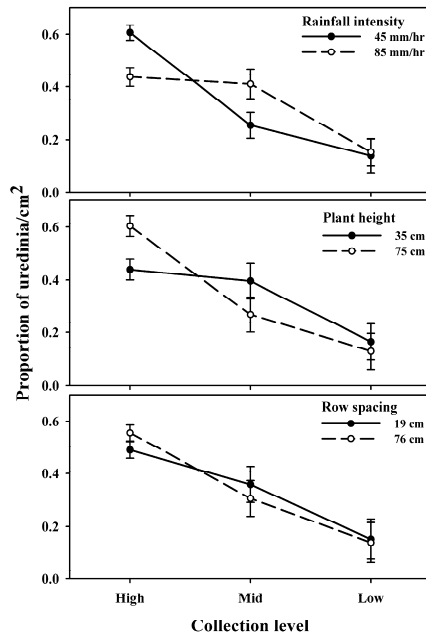
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## Introduction:

Soybean rust, caused by the fungus *Phakospora pachyrhizi*, is known to spread vast distances through the atmosphere. Rainfall washout has been indicated as the primary deposition process for this pathogen in the central soybean producing regions of the U.S. (Barnes, 2009; Isard, 2007). Determining the depth at which *P. pachyrhizi* urediniospores are deposited within a soybean canopy is critical to understanding disease development. Viable spores deposited low in a soybean canopy will be exposed to more favorable environment conditions, and thus will have a greater likelihood for infection. The objective of this poster was to determine the effects of rainfall intensity, plant height & row spacing on the vertical distribution of urediniospores deposited by rainfall within a soybean canopy.

**Figure 1.** (A) Rainfall simulator in a soybean field with the control unit. (B) A close up of spore injector on rain simulator control unit. (C) Detached leaf bioassay setup. (D) Close up of an infected leaf from the detached leaf bioassay.



**Figure 2.** The mean proportion of uredinia/cm<sup>2</sup> (± standard error) observed within the soybean canopies at 3 collection levels (CL) for treatments of RI, PH & RS. Soybean canopy CL were adjusted relative to average plant canopy height (ht) for levels of low (0.3ht), mid (0.6ht) and high (1.0ht).

**Table 1:** Main and interaction effects of rainfall intensity, plant height, row spacing and collection level on the logit [0.5\*log(y/1-y)] transformed proportion of uredinia/cm<sup>2</sup> based on a linear mixed model analysis of variance. Gray shading indicates significant ( $P < 0.05$ ) results.

Effects	df <sub>n</sub>	df <sub>d</sub>	F	Probability
Rainfall Intensity (RI) <sup>a</sup>	1	3	0.00	0.99
Plant Height (PH) <sup>b</sup>	1	6	0.69	0.44
Row Spacing (RS) <sup>c</sup>	1	12	2.37	0.15
Collection Level (CL) <sup>d</sup>	2	48	26.61	< 0.01
PH * RI	1	6	3.92	0.10
RI * RS	1	12	3.42	0.09
PH * RS	1	12	0.21	0.66
RI * CL	2	48	4.88	0.01
PH * CL	2	48	3.42	0.04
RS * CL	2	48	0.07	0.93
PH * RI * RS	1	12	0.11	0.75
PH * RS * CL	2	48	3.19	0.05
PH * RI * CL	2	48	2.03	0.14
RI * RS * CL	2	48	3.04	0.06
PH * RI * RS * CL	2	48	0.11	0.89

<sup>a</sup> Rainfall intensities produced by the simulator of 45 and 85 mm/h.

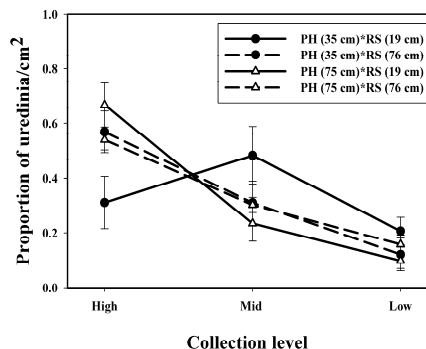
<sup>b</sup> The two soybean average canopy height of 35 cm and 75 cm.

<sup>c</sup> Row spacing observed in the soybean plots of 19 and 76 cm.

<sup>d</sup> Collection levels of the detached leaves based on the average canopy height (ht), for the three levels of low (0.3 ht), mid (0.6 ht) and high (1 ht).

## Material and Methods:

- 2 experiments were conducted in field sites of DP7220RR (Monsanto Co.) at the North Florida Research & Education Center (NFREC, Quincy, FL).
  - Sites were 100 x 30 m.
  - 2 row spacing (RS) treatments of 19 & 76 cm were planted randomly in 6 field sections (15 x 15 m).
  - Average plant height (PH) treatments the experiments were 35 & 75 cm
- Simulations of 45 & 85 mm/h rainfall intensities (RI) were repeated 4 times.
- The rainfall simulator was the experimental unit & used to establish plots of 2 x 2 m which included 150 to 200 plants (Fig. 1).
- Urediniospores were injected into the simulated rain water flow (Fig. 1).
  - Suspensions were mixed 1 min before each simulation.
  - Concentration & percent germination were recorded.
- Detached soybean leaves were used to sample rainfall deposition (Fig. 1).
  - Leaves placed on water agar (10g/L) plates to avoid dehydration.
  - Samples were placed at 3 collection levels (CL) of 0.3, 0.6, 1.0ht relative to PH within the soybean canopy.
  - Incubation was for 14 days with 12-14 h of natural sun at 24° C (±5°C).
- Disease severity values were used to estimate viable spore deposition.
- All data was standardized using proportions based on collection level.



**Figure 3.** The mean proportion of uredinia/cm<sup>2</sup> (± standard error) observed within the soybean canopies at 3 collection levels (CL) for each plant height (PH) & row spacing (RS) treatment. Each line represents a different PH & RS combination. The soybean canopy CL were adjusted relative to the average plant canopy height (ht) for the levels of low (0.3ht), mid (0.6ht) and high (1.0ht).

## Results and Discussion:

- Rainfall intensity (RI) and plant height (PH) had significant interaction effects with collection level (CL) on the proportion of uredinia/cm<sup>2</sup> (Table 1).
- The 85 mm/h RI deposited greater proportions of urediniospores into the middle and low canopy than the 45 mm/h RI (Fig. 1).
- Row spacing (RS) had no effect on the vertical distribution of urediniospores within a soybean canopy, however, there was a significant interaction of RS, PH and CL. This indicates the importance of canopy structure with age in spore wet deposition (Table 2 & Fig. 2).
- This study demonstrates the importance of RI, PH and RS in determining the vertical distribution of wet deposited *P. pachyrhizi* urediniospores within a soybean canopy.
- In general, our results suggest that between 40 & 60% of viable *P. pachyrhizi* urediniospores retained by the soybean foliage will be rain deposited in the mid and low sections of soybean canopies. This is an area where environmental conditions can be highly favorable to pathogen germination and infection.