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NATIONAL PEANUT BOARD/SOUTHEAST PEANUT
RESEARCH INITIATIVE
FINAL REPORT FOR WORK
DONE UNDER RESEARCH AGREEMENT

Report Due

Sept 30, 2005

INSTITUTION: University of Georgia

PROJECT TITLE: Efficient Irrigation for Peanut and Peanut-based Rotations

RES. AGR. NO.: 25-21-RF324-221

PROJECT LEADER: Dr. Jim Hook

EXPIRATION DATE: December 31, 2004 (extended June 30, 2005)

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Final Report
EFFICIENT IRRIGATION FOR PEANUT AND PEANUT-BASED ROTATIONS
Southeastern Peanut Research Initiative

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Studies conducted under the Efficient Irrigation for Peanut Study that was funded during four years by the SPRI included field comparisons of efficient irrigation scheduling techniques, water stress impacts on yield resulting from poor scheduling, a study of water loss from common sprinkler packages used in Georgia, and a study of impacts of incorrect over-pressurization of sprinklers. The first two studies were summarized in previous year's final report. This year's report summarizes the sprinkler package comparison. The final study, conducted during 2005, will be presented in the final report due September 30, 2006. That final report will also include an update of irrigation scheduling studies addressed earlier.

Sprinkler Package – Water Loss Study

Research Approach: At the Stripling Irrigation Research Park (SIRP), we had 4 pivots with 2 sprinkler packages each. There were 4 different packages (HI, LI, ST, SD) each replicated 2 times among the 4 pivots. The design was a RCB design with two replicates and four treatments split in time (repeated runs of the same experiment, regardless of meteorological conditions).

Earlier, Kerry Harrison, et al. determined the optimal location along the mainline and around the circle to put the center of 10 randomly placed paint bucket catch cups. The pivots were operated across and beyond the catch buckets and the catch amount was measured with a graduated cylinder. Other variables recorded for the time interval included wind speed, wind direction, temperature, relative humidity, begin and end time, flow rate, total flow, an evaporation catch bucket, and pivot pressure.

The summary of results presented below are the results of statistical comparisons, Andrea and I have completed for the catch bucket data. There were 123 test runs run over a wide variety of environmental conditions over a three year period as a portion of the SPRI funded Peanut research program. We used the following data in our analysis:

- sprinkler types (HI, LI, ST, SD)
- relative humidity
- temperature
- wind speed
- time of day

The data was analyzed using a Stepwise Regression Model. When you are comparing responses (catch can amount) that have been affected by both fixed and variable effects (RH, Wind), the regression approach is more appropriate.

Results:

- Catch cup volume was shown to be dependent on Sprinkler Type (HI-LI & SD-ST) and Humidity.
- Catch cup volume was shown to be independent of Time of Day, Temperature, and Wind Speed.
- 41% of the variation in catch cup volume is due to variation in all X variables (Sprinkler Type, Humidity, Time of Day, Temperature, & Wind Speed).

Within this 41%:

- 29.7% of the variation in catch cup volume is due to variation in the High and Low impact sprinklers;
- 5.1% is due to variation in humidity; &
- 2.7% due to variation in SD and ST sprinkler types.
- The remaining variables did not contribute a significant amount of the overall variation of the catch cup volumes.

- The Ho: catch cup volume is not linearly related to sprinkler type WAS rejected.

◦ Preliminary test showed there was no difference in using individual bucket data points and bucket averages for each test run.

The forward stepwise procedure resulted in a model containing five potential predictor variables with the significance level (“p-value”) for entry at 0.250 and removal from the equation set at 0.10. The model as a whole was nominally significant, $F = 11.4230$, $p < 0.0001$, $d.f. = 7$, with an $R^2 = 0.41$ resulting in the following regression equation:

$$Y = 210.2784 + -9.1992573X_1 + 0.6568145X_2 + -7.1906645X_3 + 123.236607X_4 + -0.9733746X_5 + -2.4510749X_6$$

Step	Variable	R ² (additive)	P-value (final)
1 (X ₁)	Sprinkler Type (HI-LI)	0.2974	P=0.009
2 (X ₂)	Humidity	0.3488	P=0.0236
3 (X ₃)	Sprinkler Type (SD-ST)	0.3757	P=0.0267
4 (X ₄)	Time	0.3875	P=0.0189
5 (X ₅)	Temperature	0.3946	P=0.0416
6 (X ₆)	Wind speed	0.4101	P=0.0849

The following graphs provide descriptive statistics:
The red line represents the “calculated” expected catch-cup volume.

The results of a Tukey-Kramer test, comparison of all pairs, are shown in the graph below. Levels not connected by same letter are significantly different.

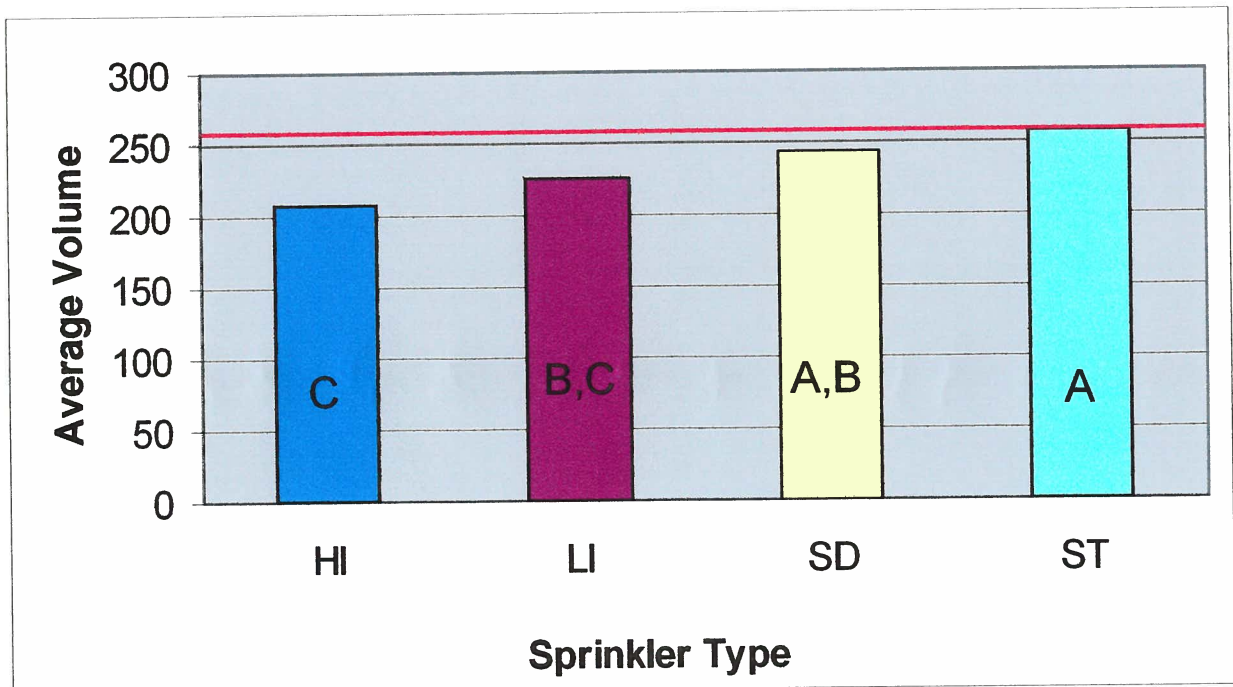


Figure 1. Average catch cup volume for each sprinkler type.

◦ Catch cup volume was shown to be dependent on Sprinkler Type (HI-LI & SD-ST).

In our testing, over all runs, it appears that by using ST, we could have 'saved' 0.095 in (50 mL) of irrigation water over using HI sprinklers and about 0.061 in (32 mL) over LI sprinklers. (we used paint buckets as catch cups – ID is 6.38 in)

Wind Speed Categories is graph below are:

- 1 = <1 mph
- 2 = 1-4 mph
- 3 = >4 mph

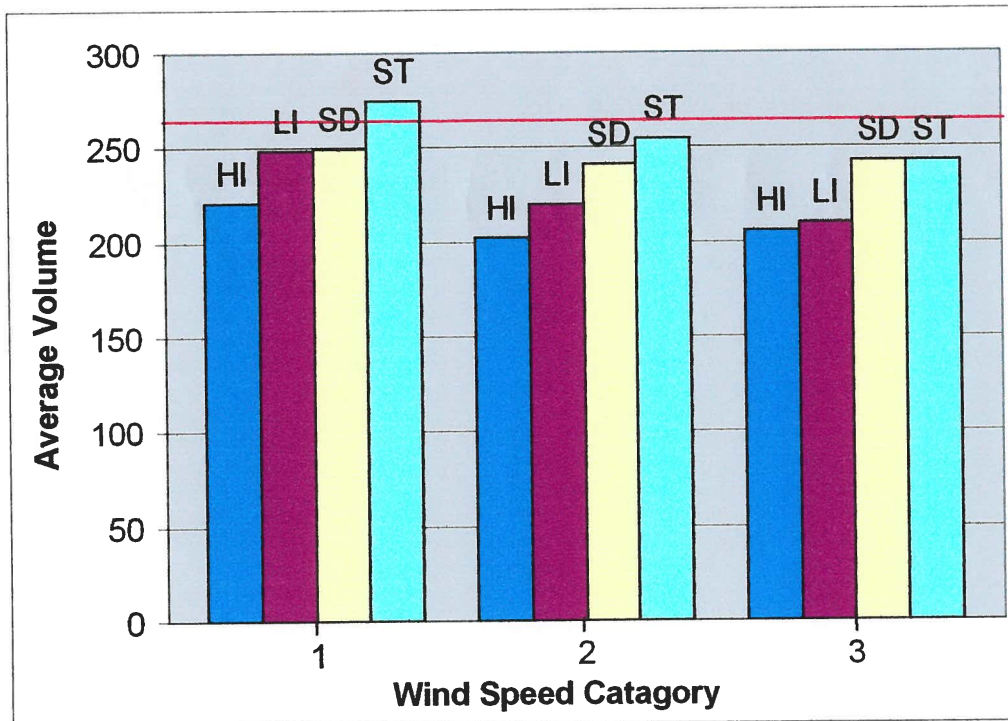


Figure 2. Average catch cup volume for each sprinkler type for 3 wind speed categories.

◦ Catch cup volume was shown to be independent of Wind Speed.

Relative Humidity
Hi equals $\geq 70\%$
Low equals $< 70\%$

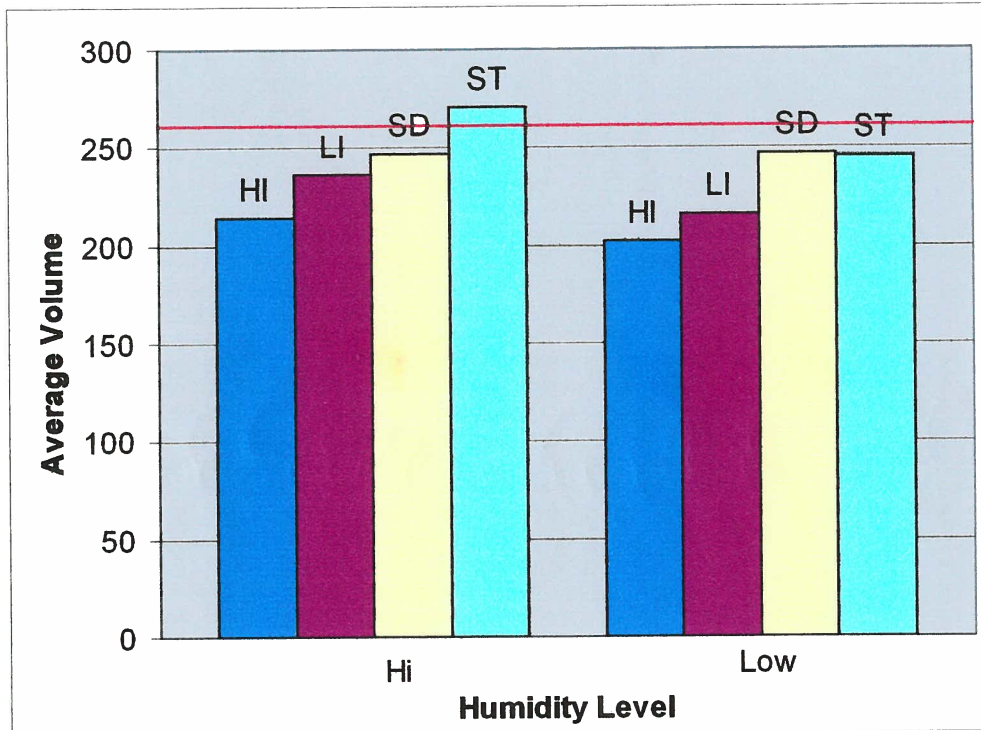
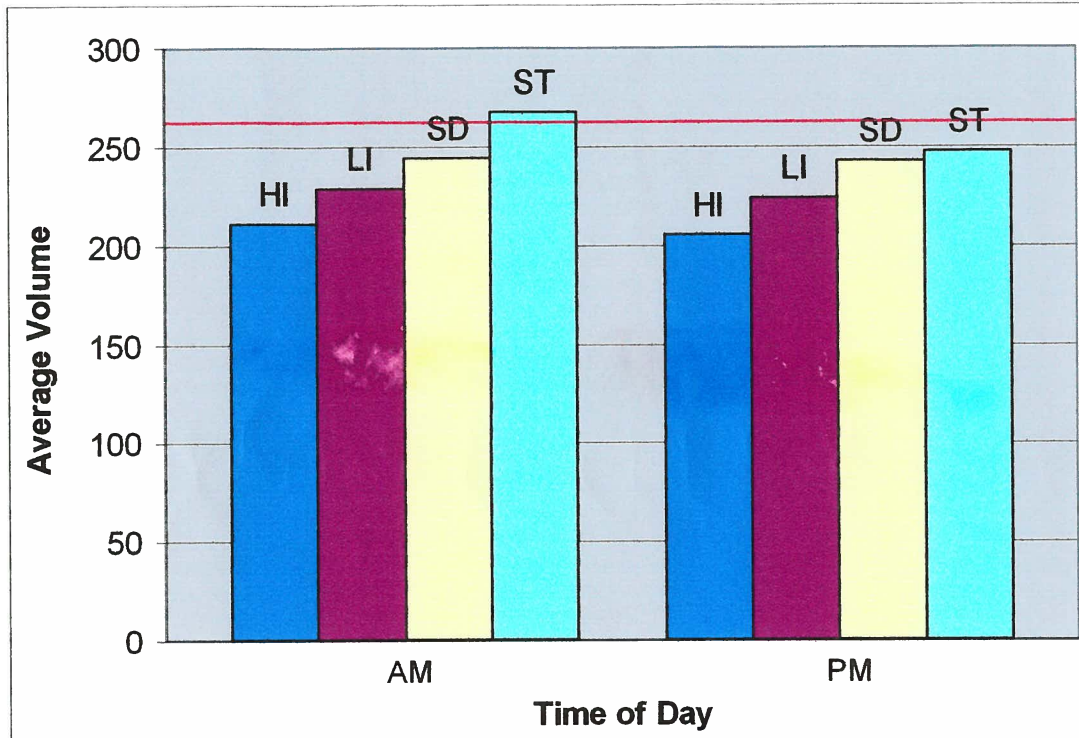


Figure 3. Average catch cup volume for each sprinkler type for 2 humidity levels.

◦ Catch cup volume was shown to be dependent on Humidity.

In our testing, it appears that by using ST in High RH, we could have 'saved' 0.107 in (56 mL) of irrigation water over using HI sprinklers and about 0.065 in (34 mL) over LI sprinklers. Under Low RH conditions, ST would have 'saved' 0.084 in and 0.057 in over HI and LI, respectively.



- Catch cup volume was shown to be independent of Time of Day

Conclusions:

Sprinkler type had the most significant effect.

Impact sprinklers contributed more to the variation than sprays.

Wind speed may not have varied enough during test to pick up a linear relationship (only 0-8 mph recorded) with volume.

ST and SD not significantly different over all tests, but sig. different from HI and LI.

ST avg. catch cup volume significantly higher than HI and LI.

In Figures 2-4, note that the ST avg catch volume exceeds the expected catch value.

Raw data was checked to see if a catch bucket or two received exorbitant amounts of irrigation.

For all test runs where ST avg catch exceeded expected, at least 5 out of 10 catch cups received catch volumes at or below the expected. So, it doesn't appear that water was dripping into the buckets off the mainline or supports. Remember that buckets were randomly placed each test run so no spatial pattern could be detected.