COMPARISON OF IRRIGATION SCHEDULING METHODS IN COTTON PRODUCTION

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Abstract

Three different irrigation scheduling techniques were compared in this study; aerial infrared, hand-held infrared, and neutron moisture gage measurements. There were four treatments with three replications of each. Treatment one was scheduled using aerial infrared imaging and analyzes performed by Agrometrics, Inc. Treatment two was scheduled using a hand-held infrared gun. Irrigations for this treatment were initiated at a crop water stress index value of 0.3. Treatments three and four were scheduled using neutron probe measurements. Treatment three was irrigated at 45% depletion of the available soil water. Treatment four was irrigated at 45% depletion of the available soil water until mid-bloom, when the strategy was changed to irrigate at 35% depletion. Yield results showed no significant difference between the treatments.

Introduction

Rising water costs coupled with static crop prices have forced many growers to re-evaluate their irrigation management strategies. More and more, growers are looking for ways to better use their irrigation water and increase their irrigation efficiency. One possible solution is irrigation scheduling. Although many devices and methods are available, side-by-side comparisons are required to evaluate how well these devices work and what are the differences, if any. This study evaluated the use of aerial infrared (IR) imaging, a hand-held IR gun, and a neutron moisture gage to schedule irrigation on large scale field plots.

Materials and Methods

The experiment was located on the demonstration farm at the Maricopa Agricultural Center, Maricopa, Arizona. The demonstration farm was used because the experimental plots needed to be at least 5 acres in size to accommodate the requirements for aerial IR readings. The field chosen was 60 acres of an 80 acre field. The field was pre-irrigated on March 9, 1994 with 30 inches of water. Planting was done on April 8, 1994. The study consisted of four treatments and three replications. Each replication was 5 acres in size. The field length was 800 feet and each plot was approximately 96 rows wide. A plot diagram is shown in Figure 1.

There were four irrigation scheduling treatments implemented in this study. Treatment one was aerial infrared (IR) readings. Agrometrics, Inc. was charged with providing information as to when to irrigate using aerial IR readings combined with their software. Readings were taken approximately twice a week when weather permitted. Agrometrics also installed neutron probe tubes in their treatment plots for their own measurement purposes.

Irrigations for the second treatment were scheduled using an IR gun. The gun used was an Everest model 510B. Reading were taken twice a week. Early in the season, individual leaf measurements were taken. As the canopy grew, canopy temperature were then taken four for each plot. The canopy measurements were taken from each corner of the plot, reading into the center of the plot. In addition to IR readings, field dry bulb and wet bulb temperature measurements were taken with a psychrometer. The threshold level used to irrigate was a crop water stress index (CWSI) value of 0.25-0.30, as recommended by Garrot and Stedman (1990).

The third and fourth treatments used neutron probe readings and soil moisture levels to determine when to irrigate. Neutron probe tubes were installed on June 6, 1994. At the time of installation, soil samples were taken, weighed, and a soil moisture calibration curve was developed. Treatment three used soil moisture readings from the neutron probe and an irrigation threshold of 45% depletion of available water. Readings were taken twice a week. Treatment four also used neutron probe reading to determine soil moisture. However, the depletion level of 45% was kept only until mid-bloom, at which point a 35% depletion was imposed. Readings were taken twice a week.

As Figure 1 shows, all plots had neutron probe access tubes installed in them. In treatments three and four, these tubes were used to measure soil moisture and determine when to irrigate. However, in treatments one and two, these tubes were only read when either of the IR treatments called for irrigation.

The plots were harvest on October 11, 1994. Four rows from each replication were mechanically harvested and weights were taken using a boll buggy mounted on scales.

Results and Discussion

The results of the yield data collected are shown in Figure 2. This data represents the lint yield based on the sample weights and the turnout from the gin. The yields averaged about 3 bales per acre. Although there were some yield differences between treatments, the differences were not statistically significant (SNK @ 0.05).

The total amount of water applied to the field was 59.5 inches, include the 30 inches of pre-irrigation. Average time to irrigate across the field was about 6 days, though this varied with the supply flow. Like the yields, there were no differences in irrigation amounts for the four treatments. Although one treatment may have indicated that an irrigation was required before another, in general, all treatments indicated a need for irrigation within days of each other.

The aerial IR treatment was completely controlled by Agrometrics and the farm manager. Unfortunately, problems early in the season did not allow for a complete season of measurement using the aerial IR. The hand held IR gun made measurement quite easy. However, early season measurements were difficult, before the canopy had closed. Also, the gun readings tended to either indicate healthy plants or a water stressed plants and did not show much sensitivity using the method in this study. The yield from the two neutron probe treatments also did not differ significantly. Both strategies (45% and 45%-35%) produced the same yield. Compared with the aerial IR and the IR gun, the neutron probe proved to be bulky and difficult to handle in the field. However, the probe was the most consistent in showing decreases in soil moisture making it easier to schedule irrigations.

References

Garrot, D.J. and Stedman., S. 1990. Scheduling Irrigation with Infrared Thermometers in Arizona.Cooperative Extension, University of Arizona,

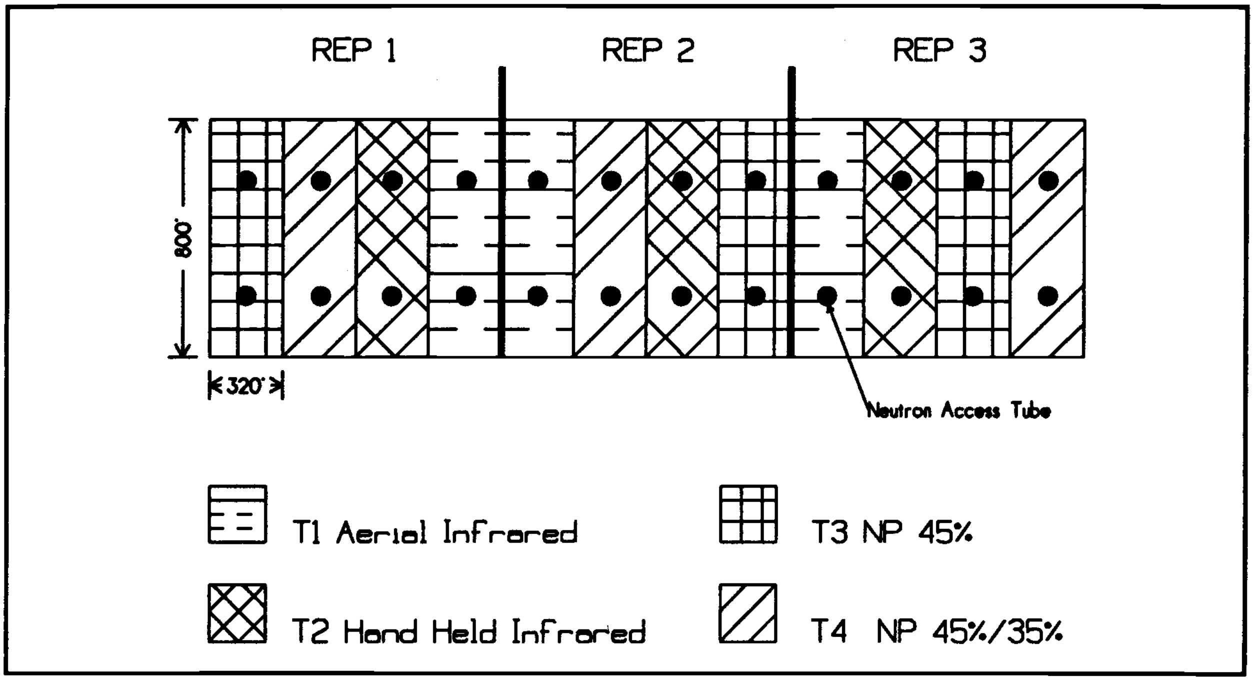

Figure 1. Diagram of the plot layout for the irrigation scheduling study at Maricopa Agricultural Center, Maricopa, AZ, 1994.

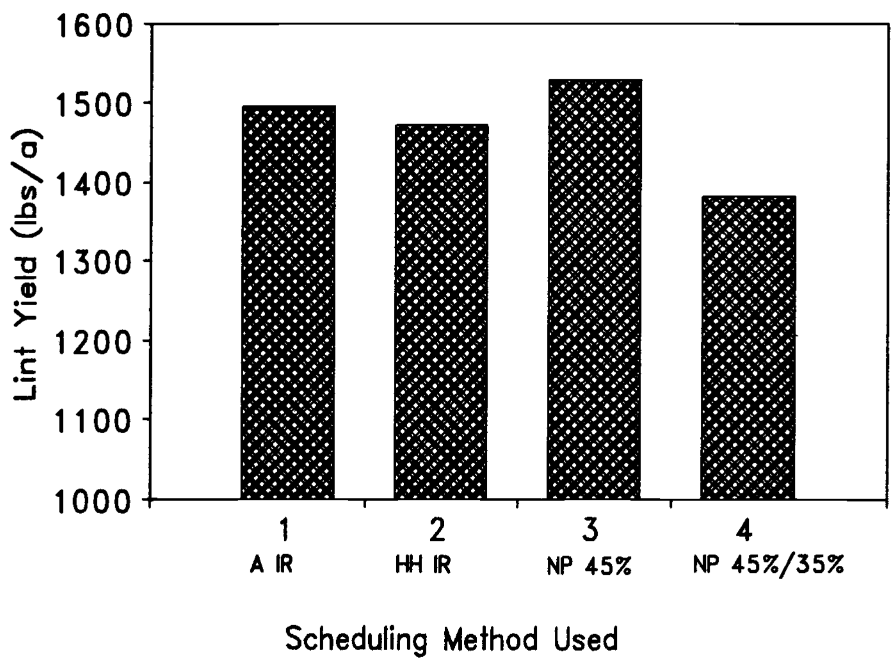

Figure 2. Lint yield data from the irrigation scheduling study at Maricopa Ag. Center, 1994. AIR=Aerial Infrared; HHIR = Hand-Held Infrared; NP=Neutron Probe; 45% and 35% are soil water depletion levels.