Comparison of Three Irrigation Scheduling Methods and Evaluation of Irrigation Leaching Characteristics

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Abstract

Three methods were used to schedule irrigations on replicated plots at the Maricopa Ag Center using DPL 90 cotton. The three methods were: a soil water balance model based on historic consumptive use curves, a soil water balance model based on the Modified Penman Equation and daily weather (AZMET), and infrared thermometry using the C.W.S.I. A potassium-bromide conservative tracer was applied at selected sites in the plots to evaluate leaching characteristics. The irrigation scheduling test was duplicated at the Safford Experiment Station and is presented in another report. Results from the 1988 data indicate that there was no significant difference in yield between the 3 methods. There was a significant difference in water applied; the historic consumptive-use curves was the lowest and the Penman equation method was the highest.

INTRODUCTION

At the present time there are no easy-to-use irrigation scheduling methods in common use in Arizona. That is unfortunate because the methods have been employed in other parts of the country for many years with successful results. The historic consumptive-use curves published by Erie et. al (1965 and 1981) have been available yet they have not been used for irrigation scheduling purposes. A major reason has been grower reliance on wells for their source of water. In most cases, scheduling was not possible because the flow of water from the wells was not enough to keep up with the demand from the planted acreage. With the arrival of CAP water into central Arizona and the creation of the AZMET weather system, it is now possible to use irrigation scheduling in real time. The purpose of the multi-year research is to evaluate 3 irrigation-scheduling methods in terms of applied water, yield, ease of use, man-hours of labor, and leaching characteristics.

METHODS AND MATERIALS

A randomized, complete block statistical design was used with the three irrigation-scheduling methods and 3 replications (9 plots). DPL 90 cotton was planted 14 April on 40-inch furrowed rows, 385 feet long. Each plot had 12 rows with a neutron access tube located one-third and two-thirds of the row length away from the water source. The tubes were installed to 10 feet and were read at 1 foot increments before and after every irrigation. Water was applied with gated-pipe and the total volume to each plot was measured with an inline meter. Standard application methods for fertilizer and pesticides were used. However, no fertilizer was applied after layby. The last irrigation was 2 September, the cotton was defoliated on 11 October and picked 2 November.

The 3 irrigation scheduling treatments were; ERIE (historic consumptive use curves), CHECKBOOK (use of daily AZMET weather data with the Penman equation), and CWSI (thermal infrared). Irrigation was initiated using the ERIE and CHECKBOOK methods when the calculated soil-moisture depletion was 50%. A value of 0.3 initiated an irrigation using the CWSI method. The neutron probe soil moisture data was used as a check on the scheduling methods and also to determine time and depth of water removal.

After harvest, soil sampling was begun to evaluate the depth of movement of the applied bromide. The samples are being analyzed for bromide, nitrate-nitrogen, and chloride content. The depth of movement of the bromide will allow for estimation of the depth of movement of the irrigation water applied following the bromide addition. The concentration of the chloride in the soil water will be compared to the concentration of chloride in the irrigation water to provide an estimate of the leaching percentage. When multiplied by the amount of water applied, that will allow a check of the estimate of the depth of irrigation water that moved below the root zone during the season as calculated from the bromide data.

RESULTS AND DISCUSSION

The irrigation results are shown in Table 1. There were some inherent problems with the field where the experiment was conducted. The first problem involved the effects of landleveling. The field had been dead leveled in 1986 and most of the cuts were on the south side (plots 107, 108, and 109); the fill area was the north side (plots 101, 102, and 103). The cotton planted in the cut area experienced reduced growth early in season. It appeared to make a complete recovery, yet the effects were noticeable in the yields from the plots. The second problem involved cotton that died in small rectagular areas in plots 101 and 102 due to a herbicide study that was conducted in 1985. The dead areas were taken into account when the yield results were determined. Since nothing had been planted on the field in 1986 or 1987, the problems had not been identified prior to the growing season.

The first year of this research was 1988 and the data concerning manhours and ease of use have not been evaluated. To prepare the field for 1989, it has been fertilized with manure and planted with barley to bring it into nutrient uniformity and to determine whether there are any residual herbicides.

Table 1. Yield and Water Applied Data.

Plot No.	Treatment	Yield (ba/ac)	Irrigation (in)	Rain (in)	Total (in)
101	ERIE	2.93	38	3.2	41.2
102	CHECKBOOK	3.15	46	3.2	49.2
103	CWSI	2.76	39.5	3.2	42.7
104	CWSI	2.89	39.5	3.2	42.7
105	ERIE	2.93	38	3.2	41.2
106	CHECKBOOK	2.84	46	3.2	49.2
107	CWSI	2.76	39.5	3.2	42.7
108	CHECKBOOK	2.56	46	3.2	49.2
109	ERIE	2.19	38	3.2	41.2

Treatment	Yield Avg (bales/ac)	Irrigation (inches)
ERIE	2.68(a)	38(a)
CWSI	2.80(a)	39.5(a)
CHECKBOOK	2.85(a)	46(b)

* Column means followed by the same letter are not significantly different ($P <= 0.05$).

REFERENCES

Erie, L.J., French, O.F., and Harris, K. 1965. Consumptive Use of Water by Crops in Arizona, Technical Bulletin 169, Agricultural Experiment Station, Univ. of Arizona, Tucson.

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