EVALUATION OF A METHOD OF IRRIGATION SCHEDULING

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INTRODUCTION

Extension programs for scheduling irrigations are in use in a number of irrigated areas, including those of southern Alberta. The benefits of scheduling, as described by Wilcox and Brownlee (7) for the Okanagan Valley of British Columbia, derive primarily from the economics of water distribution and application. Jensen (3) and Jensen *et al.* (4) stress the proper timing of water application as a primary advantage.

In southern Alberta a program of irrigation scheduling has been in operation since 1959. Evapotranspiration (Et) or crop water requirement is estimated from evaporation measurements using techniques generally described earlier (1, 2, 6). Ten years of research involving Et determination and correlation with concurrently measured evaporation preceded the introduction of the scheduling program. A further evaluation of its long-term benefits and reliability was begun at the Canada Department of Agriculture Irrigation Research Substation, Vauxhall, Alberta in 1961. This paper records the effects of scheduling on yield and water requirements of crops grown in a 4-year rotation over an 8-year period.

PROCEDURE

The rotation consisted of sugar beets, canning corn, barley underseeded to sweet clover, and sweet clover plowed down for green manure. Cultural operations and fertilizer applications were in accordance with good farm practice. Surface irrigation methods were used and the amount of water applied was measured with recording meters. Records of precipitation, evaporation, and depth to water table throughout the plot area were maintained.

Soil Moisture Determinations

On each plot at seeding and at harvest, soil moisture was determined gravimetrically to a depth of 120 cm at six locations and averaged. The soil moisture inventory thus obtained provided the starting point in the spring for the scheduling program and an end-of-season check on the effectiveness of the program.

Irrigation Treatments

Treatment 2, the scheduling procedure recommended for extension use, required that irrigation be applied whenever the available moisture within the rooting profile had been depleted by 50%. Additional irrigation treatments prescribing a higher (treatment 3) and a lower (treatment 1) moisture level were included in the study to provide a comparative assessment of the irrigation scheduling program. Treatment 3, with a minimum allowable available moisture level of 75%, required smaller amounts of water at each irrigation but at a greater frequency than usual in normal farm practice. Treatment 1, minimum level 25%, required larger and fewer irrigations and resembled normal farm practice more closely than did the other two treatments. A nonirrigated or "dry" check, treatment 0, provided a comparison of dry-land productivity and water use with that of irrigated land. The four treatments were randomized in three replications for each crop and remained constant on each plot for the duration of the study.

Scheduling Procedure

Research conducted prior to the initiation of the scheduling program indicated the following relationship of evaporation measured with an atmometer to potential evapotranspiration (5):

$$Eb \times 0.0086 = Etp$$

where Eb = evaporation (cc) from a black Bellani plate atmometer

Etp = potential evapotranspiration (cm).

This relationship is valid only while crops are fully leafed, growing vigorously, and adequately supplied with moisture (5). During the early and, sometimes, late stages of plant growth, moisture use is less than that represented by Etp. To predict the actual use at specific growth stages correction coefficients were applied to the estimated Etp. For example, the correction coefficient for corn was 0.38 throughout May and June, 0.96 during July, and 0.70 during August. These stepwise changes in coefficients are a practical simplification of the changes that take place continuously during the growing season. The above computation procedure is used by irrigation extension personnel to predict crop water use for scheduling purposes.

RESULTS AND DISCUSSION

Moisture Control

The percentage of moisture remaining in the soil in the fall (Table I) illustrates the effectiveness of the scheduling procedure in maintaining the prescribed soil moisture levels. As is to be expected treatment 3, with short irrigation intervals, met the prescribed requirements most closely. The irrigation intervals were much longer for treatment 1, and the chances that the designated minimum level would occur just at sampling time were correspondingly reduced. The nonirrigated plots had virtually no available moisture remaining at harvest.

Among treatments, the differences in soil moisture at the end of the growing season were highly significant. There were, however, no significant differences among crops, and the crop x treatment interaction was not significant, reflecting appreciable year-to-year fluctuation in precipitation. Where no irrigation was applied,

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