CHAPTER 11C

Irrigation Options to Avoid Critical Stress:
Optimization of On-Farm Water Allocation to Crops

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I. INTRODUCTION

It is recognized that proper scheduling of irrigation can increase the efficiency with which water is used. As discussed by Hiler and Howell in Chapter 11A, the objective of scheduling irrigations to maintain favorable soil moisture conditions and thus to achieve maximum economic yield is justified only if: (i) water is not limited, and (ii) costs of applying water are low. If either or both of these conditions are violated, management policies to effect the efficient use of water are more difficult to define. For example, if irrigation water is limited and deficit irrigation must be practiced, the stage of crop growth and its sensitivity to soil water deficits must be considered. Stewart et al. (1975) experimentally demonstrated that the sequencing of a limited supply of water to corn and grain sorghum is important and that an optimal sequence exists.

In order to study farm irrigation policies when water supply is limited or expensive, optimization techniques have gained increased acceptance during the last 15 years. In this chapter, some relevant optimization techniques and examples are reviewed. Basic characteristics of optimization problem formulation are presented with examples applied to irrigation management. Mathematical models are inherent in the methodology, and because of the recent emphasis on model development by agricultural researchers, the role of models and simulation in irrigation-optimization problems will be discussed. Example applications will be reviewed to demonstrate spatial and temporal considerations in on-farm allocation of water.

II. OPTIMIZATION PROBLEM CHARACTERISTICS

A goal of optimization or operations research techniques is to develop the best possible course of action for management, or the optimal solution