

**Scheduling Irrigations: When and How Much Water to Apply**

By:

Blaine Hanson  
Irrigation and Drainage Specialist

Larry Schwankl  
Irrigation Specialist

Allan Fulton  
Farm Advisor (former), Kings County

A Handbook for Water Managers  
Water Management Handbook Series  
(Publication Number 3394)  
University of California Irrigation Program University of California, Davis  
1999

About this publication:

Scheduling Irrigations: When and How Much Water to Apply is the seventh in a series of water management handbooks prepared by the University of California Irrigation Program with funding provided by the California Energy Commission and the U.S. Department of Agriculture Water Quality Initiative. These publications are intended to help water managers address a range of practical irrigation issues.

Other titles in the series include: Agricultural Salinity and Drainage; Surge Irrigation; Irrigation Pumping Plants; Drip Irrigation for Row Crops; and Micro-irrigation of Trees and Vines.

Table of Contents:

***I. Introduction***

***II. List of Tables***

***III. List of Figures***

***IV. A. Introduction to Irrigation Scheduling***

Benefits of Irrigation Scheduling

Uniformity and Irrigation Efficiency

What is an Inch of Water ?

How Much Water Was Applied and How Long Should You Irrigate?

***V. B. How Soil, Plants, and the Atmosphere Interact***

***Evapotranspiration***

Evapotranspiration, Applied Water, and Crop Yield

Water Flow in Plants

Water Uptake by Roots

Critical Growth Stages

***C. Estimating Evapotranspiration: Climate-Based Methods***

Determining Crop Evapotranspiration

Reference Crop Evapotranspiration from Climatic Data

Reference Crop Evapotranspiration from Evaporation Pans

Using Real- Time Reference Crop Evapotranspiration for Irrigation Scheduling ,

Using Historical Reference Crop Evapotranspiration for Irrigation Scheduling and System Design

Crop Coefficients for Annual Crops

Crop Coefficients Under Subsurface Drip Irrigation

Crop Coefficients for Trees and Vines

Irrigating Young Trees and Vines

Seasonal Crop Evapotranspiration

VI. D. Procedures for Developing an Irrigation Schedule

Irrigation Scheduling Procedure for Furrow, Border (Flood), and Sprinkler Irrigation :

Irrigation Scheduling Procedure for Micro-irrigation of Trees and Vines

Irrigation Scheduling Procedure for Drip Irrigation of Row Crops

VII. E. Measuring Soil Moisture for Irrigation Scheduling

Soil Texture

Soil Moisture and Tension

Available Soil Moisture

When Should You Irrigate? Recommended Soil Moisture Tensions and Allowable Depletions

Measuring Soil Moisture

Soil Sampling

Estimating Soil Moisture Depletion by Soil Appearance and Feel

Tensiometers ,

Electrical Resistance Blocks

Neutron Moisture Meters

Dielectric Soil Moisture Sensors

**F. Plant-Based Methods for Scheduling Irrigations**

Visual Symptoms

Pressure Chamber (Bomb) Method with Emphasis on Cotton Irrigation

Infrared Thermometers (Guns)

G. Special Considerations

Irrigation Scheduling Under Shallow Water Tables

Irrigation Frequency, Salinity, Evapotranspiration, and Crop Yield.

Irrigation Scheduling Under Low-Infiltration Soils.

Effective Rainfall

Regulated Deficit Irrigation of Trees and Vines

Regulated Deficit Irrigation of Row Crops

Irrigating with Limited Water.

VIII. Appendices

Appendix A. Crop Coefficients of Annual Crops

Appendix B. Crop Coefficients of Trees and Vines

Appendix C. Historical Reference Crop Evapotranspiration.

Appendix D. Available Soil Moisture, Allowable Depletions, and Typical Root Depths ,

Appendix E: Worksheets for Developing an Irrigation Schedule

## Introduction:

It is well known that crop yield is directly related to evapotranspiration, or crop water use. The higher the evapotranspiration, the larger the crop yield until maximum yield is reached at maximum evapotranspiration. It is also well known that insufficient soil moisture is the one factor most likely to limit evapotranspiration. Evapotranspiration, and thus crop yield, is reduced when the soil moisture falls below a threshold value.

One purpose of irrigation scheduling is to determine when to irrigate. Irrigations should occur at intervals such that crop yield is not adversely affected by insufficient soil moisture. For furrow, flood, and sprinkler irrigation methods, the irrigation interval depends on potential evapotranspiration, soil type, and allowable depletions.

This manual contains information to help establish an irrigation schedule that will prevent crop yield reductions due to insufficient soil moisture. For microirrigation methods, irrigation scheduling is less complicated and only requires knowing crop evapotranspiration relative to the amount of applied water.

This manual provides information on developing an irrigation schedule for microirrigation methods.

Regardless of the irrigation method, measuring or monitoring soil moisture is recommended. This manual describes methods used for measuring or monitoring soil moisture, installation of soil moisture sensors, and interpretation of readings.

Adjustments to irrigation schedules may be needed where shallow water tables occur, where water infiltration rates into the soil are small, and where excessive levels of soil salinity occur. Information is provided in this manual to help irrigators understand the uniqueness of these conditions and how to adjust their water management strategies to account for these conditions.

A second purpose of irrigation scheduling is determining the amount of water applied. Information is contained in this manual on the use of flow meters, how to calculate the amount of applied water, and using soil moisture sensors to determine if an irrigation is adequate.

The material in this manual is based on results of numerous research and field projects by University of California, Cooperative Extension specialists, farm advisors and faculty at the University of California, Davis. Any questions about the manual can be directed to the authors: Blaine Hanson, Irrigation and Drainage Specialist, and Larry Schwankl, Irrigation Specialist, (530) 752-1130.

## Questions or comments:

Please direct any comments or questions to Larry Schwankl, UC Irrigation Specialist; Blaine Hanson, UC Irrigation and Drainage Specialist, Department of Land, Air and Water Resources, University of California, Davis, Davis, CA 95616; Telephone number: (530) 752-1120 Fax number: (530) 752-5262;

or Terry Prichard, UC Water Management Specialist, 420 S. Wilson Way, Stockton, CA 95205; Telephone number: (209) 944-3711.

Water Management Series publication number 94-01

**ORDERING INFORMATION:**

Copies of this publication can be ordered from:

Cooperative Extension Office  
Department of Land, Air and Water Resources  
113 Veihmeyer Hall University of California  
Davis, California 95616  
(530) 752-1130

