

THE NEBRASKA MICROCOMPUTER IRRIGATION SCHEDULING SOFTWARE

Ron Roeber & Dr. Norm Klocke
WCR&EC - University of Nebraska - Lincoln
Route 4 Box 46A
North Platte, NE 69101

Background

The University of Nebraska has long recommended using the "checkbook" method of irrigation scheduling. This approach to scheduling treats the soil water balance as if it were a "bank account". This balance is updated when deposits are made (rainfall and/or irrigation) and when withdrawals occur (crop water use). The minimum allowable balance of this account is the point at which crop yield is reduced as a result of water stress. To keep the account from going into the red, deposits in the form of irrigation should be applied to replenish the water balance. As is the case with real checking accounts, the depositor should check with the bank to see that his records are the same as the bank's; using the checkbook method of irrigation scheduling, this verification can be accomplished with moisture monitoring equipment such as tensiometers, moisture blocks or a soil probe.

Although simple in concept, the "checkbook" method of irrigation scheduling requires the irrigator to repeat several tedious mathematical calculations, tasks that are well suited to a computer. The computer network AGNET featured one of the first accessible irrigation scheduling programs. The AGNET software was based on the checkbook method and included direct access to an extensive library of weather and crop water use information.

Over the course of the last five years, microcomputer technology has become widely distributed. The AGNET computer network suffered a decline in users and finally was discontinued, largely because of forces created by the popularity of microcomputers.

Irrigators and consultants that want to use computers for irrigation scheduling have to purchase specially designed microcomputer software or develop their own solution with off the shelf software tools. Some have successfully adapted spreadsheets such as *Lotus 1-2-3* to the task of calculating soil water balances and crop water use. Unfortunately, home grown computer programs are generally difficult to use by anyone except the developer. Additionally, the current selection of irrigation scheduling software for use in the northern and central high plains seems limited.

During the spring and summer of 1989 we built an irrigation scheduling program for microcomputers base upon the "checkbook" method of scheduling, recommended by the University of Nebraska. We used the commercial database Paradox as the engine for the program.

In 1990 we offered the software to a dozen sites for testing. After completion of the growing season, we assembled the comments from the test sites and revamped the program by fixing bugs and adding features to help make the program more useful.

Special Features

The software is tentatively called *PC-Irrigate*. The menu driven software constructs a checkbook ledger for each irrigated field stored in the program. In addition to tabulating soil water balance and predicting irrigation needs, *PC-Irrigate* contains the following features:

1. Prints reports and graphs of soil water balances and crop water use.
2. Allows the use of multiple weather stations.
3. Can import weather files from University of Nebraska WEATHER bulletin board.
4. Rainfall can be entered for all field records on one screen.
5. The program can print a predicted irrigation report which will list the number and timing of irrigations needed until the end of the season in the absence of future rainfall.

Required Inputs

The current version of the program requires the following input and steps of operation:

1. Enter information about the soil and crop into a field record. The following information is required and many of the options are available from pop up menus.
 - A. Soil Type
 - B. Crop
 - C. Crop Maturity
 - D. Emergence Date
 - E. Irrigation System
 - F. Well Capacity
 - G. Moisture Monitoring Method
2. Enter a beginning water balance for the field. You may enter an actual value or assume a full soil water profile. In either case you will need to provide the following information to start estimating future irrigation needs.
 - A. Date to begin water balance calculations -- what is the first date weather data will be entered.

- B. The amount of soil water available to the crop on the day weather data will first be entered.
3. Use the program as a scheduling tool.
 - A. Enter or import weather and crop water use information as it becomes available.
 - B. Enter irrigation dates and the net amount of each irrigation (the software will help calculate the net irrigation).
 - C. Enter date and amount of each rainfall event.
 - D. Have the software calculate a "Must begin irrigation before.." date.
 - E. Repeat process A through D as needed throughout the irrigation season.

Program Operation

The *PC-Irrigate* treats each day as an entry into the checkbook log. Unlike a checkbook entry which is either a credit or a debit, an *PC-Irrigate* entry always contains a debit (daily water use) and may also include some credit (rainfall and/or irrigation). By using the previous day's balance along with debit and credit information for the current date, the new daily water balance is calculated. When updating the water balance, actual weather data is used to calculate growing degree days (GDD) for corn and beans. The accumulated GDD value is used to estimate the approximate rooting depth of the crop as well as the crop water use capacity.

PC-Irrigate includes a file containing average, normal GDD values from March 15th through November 30th for four different regions of Nebraska. When weather data for a date is absent, a expected GDD value can be obtained from this file so that crop water use can be estimated.

Weather information in the form of actual temperature and ET should be entered into the software when it becomes available. Once weather information is updated the user can select a recalculation option within *PC-Irrigate* to predict the date when the next irrigation should be applied. The software will then update the current soil water balance for each day containing new weather data using calculated water use, irrigation and rainfall amounts. When the last date of available weather data is reached, *PC-Irrigate* continues to update subsequent daily water balances using projected water use until an irrigation date is found. The irrigation date can be found using a view command or by printing a report.

Weather and ET data may be entered by hand from sources such as newspaper articles or radio reports. Additionally, weather and ET data may be imported directly from the *IANR Weather Bulletin Board*. *PC-Irrigate* contains a routine that will translate

weather data from a downloaded, bulletin board text file into a format which updates the weather files in the program.

A special feature of the program is the ability to adjust the soil water balance by using the appearance and feel method of soil water estimation. *PC-Irrigate* will also accept readings from tensiometers and soil moisture blocks to update the soil water status.

Considerations

Currently, *PC-Irrigate* works for the following three crops: corn, soybeans and alfalfa. Crop growth projections have only been prepared for Nebraska.

Plans

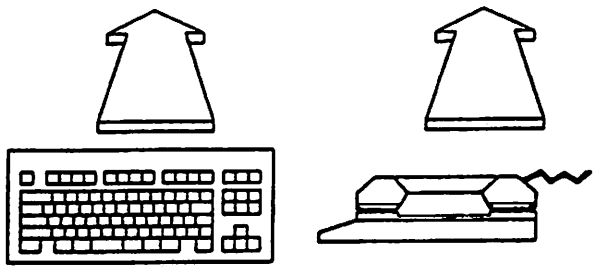
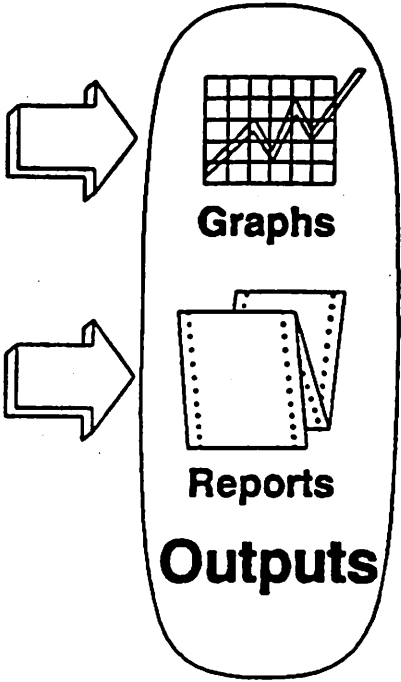
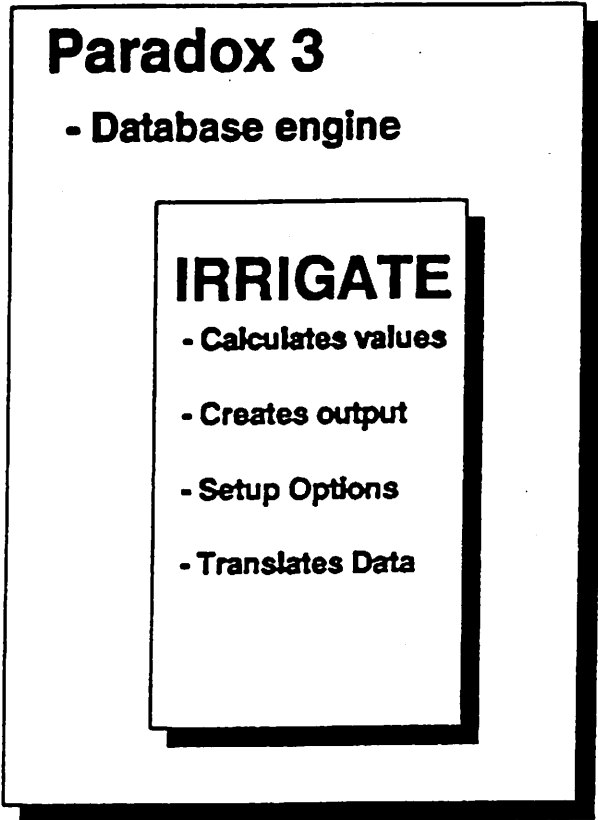
The documentation and review process will occur during the winter of 1990-1991. *PC-Irrigate* should be available for purchase in the spring of 1991.

Hardware Requirements

IBM PC, XT or compatible
640K of RAM
Hard Disk Drive
DOS 2.10 or higher
Graphics capable monitor suggested but not required

Supporting University of Nebraska Extension Publications

NebGuide G85-753 *Irrigation Scheduling Using Crop Water Use Data*
NebGuide G84-690 *Estimating Soil Moisture by Appearance and Feel*
NebGuide G78-393 *Water Measurement Calculations*
EC84-724 *Irrigation Scheduling Using Tensiometers in Sandy Soil*
EC89-723 *Irrigation Scheduling Using Soil Moisture Blocks in Silty Soil*



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