CANDI: A decision support system for management of agricultural pesticides with irrigation

R. C. Peralta
Utah State University

A. H. Aly

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CANDI's Input and Output

CANDI runs on an IBM PC or compatible with at least 512 K of RAM, hard and floppy disks. CANDI has a sophisticated user interface designed for people having minimal PC experience. CANDI presents output as full-screen enhanced graphics. Figures 2-5 show some CANDI outputs (see Aly and Peralta, 1993).

References


The use of pesticides is an integral part of today's agriculture. Pesticides contribute significantly to improved crop productivity and to public health. Some pesticides, even in extremely low concentrations, can pose a risk to human health and to the environment. Applied to plants or soil, pesticides can leach to the groundwater or may be washed off by surface water. A portion of water that has fallen on the earth, either from precipitation or irrigation, infiltrates the soil through pore spaces. As water moves downward under the influence of gravity, it dissolves materials, including pesticides and other chemicals. Once this contaminated water reaches the groundwater aquifer, horizontal and vertical movement of the pesticide will occur.

Objective

The objective of this fact sheet is to describe a user-friendly Decision Support System, CANDI (Figure 1), that can aid managing agricultural pesticides and irrigation systems by considering their groundwater contamination potential (Aly and Peralta, 1993). The acronym CANDI stands for Chemicals AND Irrigation.

CANDI facilitates estimating the relative reduction of potential pesticide contamination of groundwater achievable by improved water/pesticide management. By comparing the potential contamination results of different water management schemes, best management systems (BMSs) can be selected. When BMSs are implemented, the likelihood of groundwater contamination is reduced. CANDI uses the concept of relative amount of pesticide. The relative amount is the fraction of the applied chemical that exists in the soil profile by the time the pesticide reaches groundwater.

| Figure 1. Flow Chart of CANDI. |
evaluation (probably the depth to water table or capillary fringe). Figure 2 shows typical output from CANDI for this scenario.

2. For a selected range of possible irrigation system designs, CANDI can show which irrigation system design will result in the least relative amount of pesticide reaching a specific depth. For this option, the user provides CANDI with the pesticide's physical and chemical properties, application dates, cultivated crop, irrigation system, and weather information. For the surface irrigation system, CANDI produces curves showing uniformity coefficient and fraction of area adequately irrigated. For sprinkler irrigation systems, relative amount is shown as a function of furrow inflow rate for a range of furrow lengths. Figure 3 shows typical output from CANDI for the furrow irrigation comparison option.

3. CANDI can delineate the zones of contributing groundwater to specified wells during prescribed travel times. This permits the user to know where using pesticides is especially hazardous to groundwater consumers. For this optional output, the user must provide CANDI with pumping wells data and aquifer parameters (storativity and transmissivity or hydraulic conductivity). Figure 5 shows typical output from CANDI for the wellhead protection area option.

Predicting the amount of pesticide that will leach to the groundwater involves using several computer simulation modules in series. CANDI facilitates and automates this process. CANDI is designed for use by persons only slightly familiar with groundwater hydraulics or chemical leaching processes.

Methodology

CANDI contains several simulation modules. The modules are efficiently coded and integrated to achieve rapid processing for all applications (Figure 1). The first module simulates the irrigation system, either furrow or sprinkler. In any irrigation system, reduction in potential pesticide contamination can be achieved by efficient water application. Efficiency, in turn, is a function of several factors.

In furrow irrigation, efficiency is a function of the furrow length, inflow rate, topography, and soil characteristics. These variables are used as inputs for the surface irrigation simulation module, part of SIRMOD (Walker and Humpherys, 1983). It predicts the water storage efficiency for a specified surface irrigation system at the site of interest and for a specific irrigation schedule. The module predicts the total infiltrated depth of water for the prescribed combination of parameters. CANDI provides a database of information needed to apply this simulation approach to Utah conditions.