

**Best Management Practice Modeling Project**  
**FDACS – UF/IFAS**  
**James W. Jones and K. J. Boote (Co-PIs)**

**Deliverable 5:     Validate NUMAPS in-season  
decision support tool for BMPs of  
citrus on the central ridge.**

**Prepared by:     Kelly Morgan and Howard Beck**

**Date:                     May 28, 2007**

**Task for Year 3:**  
**Deliverable 5a**

Develop improved guidelines for more efficient water and nitrogen use in citrus.  
Develop grove specific irrigation management and N recommendations that are site-specific BMPs.

**Status:**

Development and testing of the user interface for ridge citrus irrigation and nitrogen BMP site-specific recommendations and management is complete.

**Summary:**

The objective of this task was to create a user interface that would provide citrus growers with 1) irrigation scheduling to optimize N uptake based on estimated soil water content and daily ET, 2) record keeping to determine compliance with irrigation and nitrogen BMPs, 3) determine current estimated soil water and N concentrations at selected soil depths and locations as indications of BMP validation, and 4) simulation of effect of irrigation and rainfall on future N application. To accomplish these goals, The following functions were added to the program 1) individual daily irrigation scheduling by block to optimize nutrient uptake and reduce leaching; 2) weekly, monthly, and yearly report generators that provide records of irrigation and N applications on a block by block basis; 3) graphs of soil water and N concentrations at selected soil depths and locations; and 4) graphical representations of simulated soil water and N concentrations over a user selected period of time given user defined rainfall events and N applications assuming that irrigation schedules determined by the model are followed.

**Deliverables:**

Modification of the NUMAPS model and development of the user interface for record output and simulations described below as required for year three of deliverable 5.

## **Details:**

The NUMAPS decision support system was designed with environmental, irrigation, and fertilization information provided daily. The model estimates soil water and nitrogen balances in multiple soil compartments under a mature citrus tree utilizing empirical relationships for uptake and movement of both water and nitrogen. The model requires initial setup information including tree size, spacing, soil type parameters and irrigation setpoints. Water and nitrogen balances can be run simultaneously for several separate citrus blocks. Once initialed, the model requires ET estimates, irrigation and nitrogen application data and rainfall amounts on a daily time step.

### ***Year three activities –NUMAPS BMP decision support user interface***

**User interface functions for NUMAPS.** One of the final objective of deliverable 5 is to develop improved guidelines for more efficient water and nitrogen use by developing grove specific irrigation and N recommendations that comply with BMPs. The working group including Dr. Brian Boman, IFAS BMP coordinator, determined the best form of scheduling and N recommendations provided by the NUMAPS system. An interface was developed that would provide four key sets of information needed by citrus groves to stay compliant with current BMPs.

**Irrigation scheduling.** A “work order” system was developed that provides the user of NUMAPS with block specific irrigation schedules (Fig. 1). The irrigation schedules provide information on duration of irrigation required for each block for each of three days. Three days of irrigation times are given in the event that a given block can not be irrigated on the specified date (e.g. manpower limitations or equipment failure). In the event an irrigation can not be provided in a timely manner, the extra days provide increased irrigation times to account for the added water use.

**Compliance record keeping.** Records of water use (irrigation events) and N applications are required to prove that a grove is in compliance with irrigation and BMPs. To provide the required records, reports can be created on a weekly, monthly, or yearly basis for each production block (Fig. 2). Information on total water use, rainfall, N application, and estimated N leaching is provided in reports for the three time periods.

**Graphical display of impact of irrigation and nutritional practices.** Citrus BMPs utilize IFAS annual and seasonal recommendations for irrigation and N applications. To determine the effectiveness of these recommendations on a site-specific basis, graphs of soil water and N concentrations can be generated by the used for selected time periods, soil depths, and locations (Fig. 3). These graphs would be the basis of any site-specific adjustments made by the growers to existing day-to-day decisions.

**“What if” simulations.** For BMPs to be effective, growers must have an improved understanding of the impact of management decisions on soil nutrient use and nutrient use efficiencies. The goal of irrigation and nutrient BMPs are to optimize the use of both water and nutrition to improve the uptake of both and reduced the leaching of nutrients. The simulation tool added to NUMAPS provides citrus growers with a means of estimating the short-term impact of irrigation and N application timing

decisions on future soil N concentrations and leaching. The grower provides future rainfall events and N applications. The program assumes that irrigation events will occur at the interval and duration scheduled by the model over the duration of the simulation. Outputs are the estimated soil water and N concentrations for selected soil depths and locations and can be displayed graphically (Fig. 4). Thus, the goal of this simulation tool is to provide the grower with a reliable source of information on the impact of irrigation and nutrient application decisions.

**Interface Testing.** Testing of the user interface described above will begin in the second half of 2007. A list of willing citrus growers has been compiled. Instruction on the use of the model and related user guide will begin soon. Funding for this part of the model development is funded by Section 319 grant from FDEP. This grant, a previous Section 319 grant, and the current FDACS grant have funded various portions of the NUMAPS model development. Table 1 lists the various phases of model development and the grant funding the work.

Table 1. Phases of development in the NUMAPS project and associated funding sources.

| Years     | Description                                                   | Granting Agency   | Grant                                                                                                                     |
|-----------|---------------------------------------------------------------|-------------------|---------------------------------------------------------------------------------------------------------------------------|
| 2001-2004 | Field Data Collection                                         | FDACS             | "An expert system for precision management of nitrogen in citrus production"                                              |
| 2003-2006 | Model code development                                        | FDEP, section 319 | "Implementation and growers evaluation of a web-based nutrient management plan support (NUMAPS) system for Florida crops" |
| 2005      | Validation data sets                                          | FDACS             | "Integration and verification of water quality and crop yield models for BMP planning"                                    |
| 2006      | Validation of NUMAPS and interface with WAM                   | FDACS             | "Integration and verification of water quality and crop yield models for BMP planning"                                    |
| 2006-2007 | Development of NUMAPS user guide and searchable BMP text tool | FDEP, section 319 | "Implementation and growers evaluation of a web-based nutrient management plan support (NUMAPS) system"                   |

|           |                                                                       |                   |                                                                                                                           |
|-----------|-----------------------------------------------------------------------|-------------------|---------------------------------------------------------------------------------------------------------------------------|
|           |                                                                       |                   | for Florida crops”                                                                                                        |
| 2007      | Development of BMP interface for NUMAPS, and testing of WAM interface | FDACS             | “Integration and verification of water quality and crop yield models for BMP planning”                                    |
| 2007-2008 | Testing of NUMAPS user interface                                      | FDEP, section 319 | “Implementation and growers evaluation of a web-based nutrient management plan support (NUMAPS) system for Florida crops” |
|           |                                                                       |                   |                                                                                                                           |

### ***Conclusions***

The modifications required for grower use of NUMAPS as a BMP implementation tool was the goal of work conducted during the current time period. A user interface needed for NUMAPS to develop site-specific irrigation schedules, report water and N applications, display soil water and N concentrations for evaluation by the grower, and modification of grower decisions through use the of simulations has been completed.

### ***Future activities – Year three***

The last remaining deliverable for NUMAPS is the testing of the NUMAPS/WAM interface developed in year two. Data files and test procedures are being compiled and will be evaluated over the next few weeks in conjunction with SWET. This deliverable is estimated to complete in July.

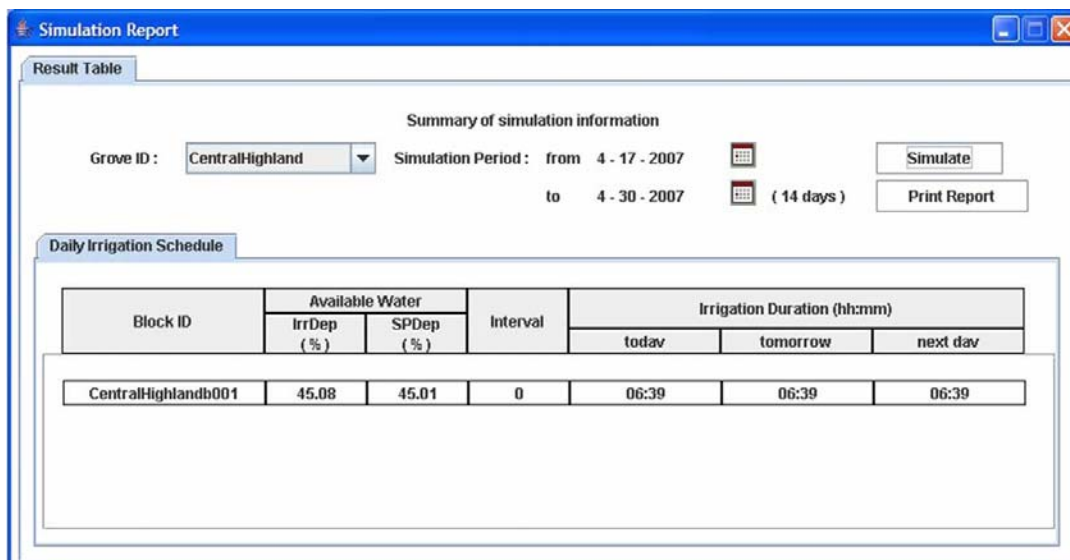


Fig. 1. Irrigation schedule or “work order” giving irrigation requirements for various blocks in selected grove.

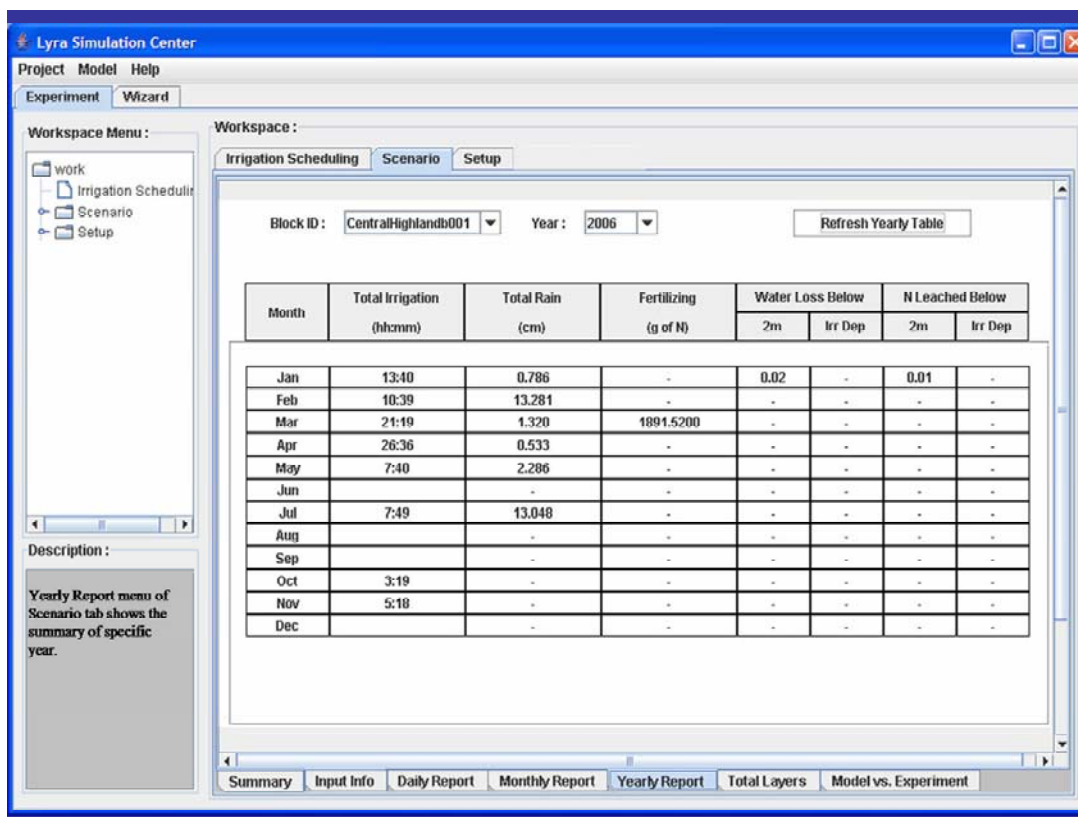


Fig. 2. Monthly report with irrigation and rainfall amounts, and estimated water loss and N leaching below the root zone for selected dates and grove.

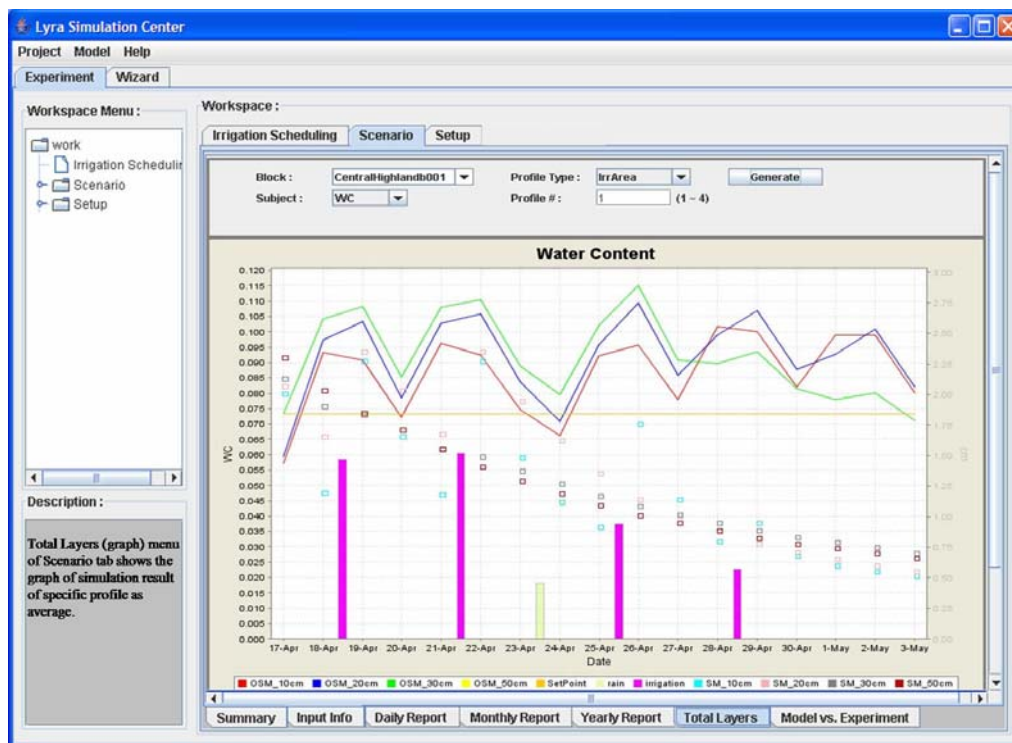


Fig. 3. Graphical representation of soil water content and water additions for a selected date and grove block.

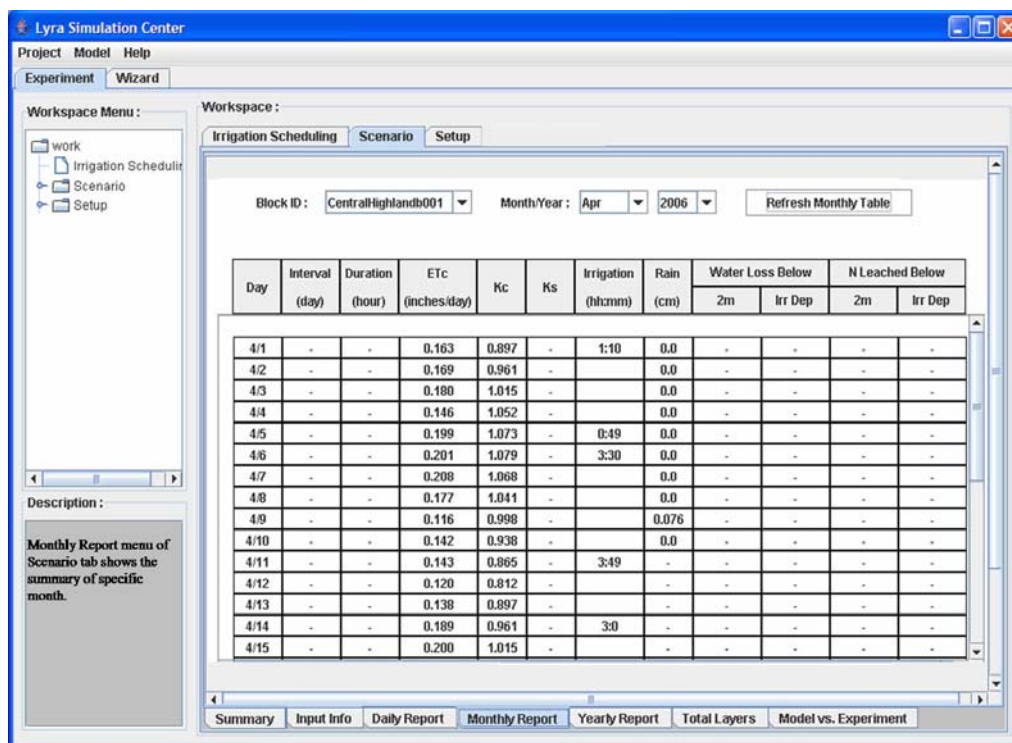


Fig. 4. Results of simulation run including water use, and estimated water loss and N leaching.