Report for 2003FL38B: Evaluation of Water Use and Nutrient Leaching with High Frequency Irrigation for Use in Best Management Practices

There are no reported publications resulting from this project.

Report Follows

Title: Evaluation of Water Use and Nutrient Leaching Under High Frequency Irrigation for Use in Best Management Practices

Focus Categories: WQN, WQL, IG

Keywords: Water Use Efficiency, Irrigation Management, Agriculture, Nutrients, Fertilizers, Groundwater Quality, Leaching, Nitrogen, Percolation, Solute Transport, Water Quality

Duration: 03/01/2003 to 02/29/2003 (no-cost extension submitted to continue through 2/2005)

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Congressional District: 6

Statement of critical regional water problems and research objectives:

As a result of increased competition among industrial, residential, commercial, and agricultural water users throughout Florida, much of the state will not be able to meet projected water needs in the future. Methods to optimize current uses of water including agricultural irrigation need to be developed. In addition, nitrate levels in the ground water and surface water of the Suwannee River basin have been increasing. Biological growth in the Suwannee River is limited by nitrogen; therefore, excess amounts of this nutrient input into the system results in increased growth of algae and other organisms. Much of the nitrate is believed to be a result of intense agricultural production with vegetable production being a major agricultural component of the region. The objective of this project is to assess the performance of soil moisture based drip irrigation under plasticulture on green bell pepper at minimizing irrigation water use and movement of nitrogen below the crop root zone. Soil sampling and injection of a water soluble dye will enable quantification of nutrient movement within and below the root zone and demonstrate to producers and other interested parties the movement of water within and below the crop root zone. The hypothesis is that high frequency small irrigation events will minimize irrigation water use and nitrogen leaching compared to typical practices while maintaining economical yields. There is a balance between maximizing crop yield and minimizing environmental impact. Comparisons will be made between maximum yield and minimum environmental impact.

Methods, procedures, and facilities

The experiment in 2003 was located in the Suwannee Basin at the NFREC-SV near Live Oak, FL. The experimental design consisted of four treatments replicated four times in a randomized complete block design. The bell pepper crop was fertilized according to Institute of Food and Agricultural Sciences (IFAS) recommendations. This consisted of application of nutrients based on soil test results with 25% of seasonal nitrogen applied as a granular pre-plant and the remaining 75% injected once each week at concentrations according to crop stage of growth. Treatments were established as follows: A1, automatically controlled irrigation events based on a soil moisture sensor with an integrated valve and controller (Model Flori 1, Netafim USA, Fresno, CA) set at a low soil moisture content (controller setting of “3”, “0” being dry and “10” being wet); A2, automatically controlled medium soil moisture content (controller setting of “6”); A3, automatically controlled high soil moisture content (controller setting of “9”); M1, once or twice daily manual irrigation event typical of good farmer management. The soil moisture sensor relates the dielectric constant of the soil to the amount of moisture present.

Automatically irrigated treatments consisted of one valve irrigating all replicates. The sensor was buried in one of the replicated plots 10 cm below the soil surface as suggested by the manufacturer. Typical, farmer drip irrigation management consisted of 60 minutes of irrigation daily when vegetables were in the first third of their growth, 60 minutes twice daily at the beginning of fruit set, and 90 minutes two times each day during fruit set and harvesting. Totalizing flow meters were installed on each treatment and water usage was recorded daily.

Time domain reflectometry (TDR) probes (Model CS-615, Campbell Scientific, Inc., Logan, UT) were installed at two depths in each plot, 15 cm and 30 cm, to monitor soil moisture status throughout the season.

Soil samples were collected from each plot prior to planting and every two weeks of the bell pepper crop. Samples were collected every 30 cm down to 150 cm. Samples were refrigerated for transport to the laboratory. Samples were extracted and analyzed for water content, NO_3-N and NH_4-N at the University of Florida Analytical Research Laboratory in Gainesville, FL following standard methods and procedures.

A concentrated, water-soluble dye was injected into the drip irrigation system several times during pepper production.

Total and marketable yield was determined at harvest.

Principle Findings and Significance:

Green bell peppers were transplanted on March 26, 2003. Shortly thereafter, nighttime air temperatures dipped below freezing which damaged the transplants. This caused a two week delay in normal pepper growth. The irrigation treatments were initiated after two weeks of time based irrigation to establish the plants. By early May it was clear that the automatic irrigation valves were not working properly and that the plants were stunted due to the freeze in early April. However, it is not uncommon to have to make adjustments to the valves early in the season to optimize their performance. In previous work, the valves performed the best at the middle and end of the season when water use was the greatest. In early June several intense thunderstorms resulted in lightning strikes on the research site. This irreparably damaged the soil moisture based irrigation control valves and 8 of the buried TDR soil moisture sensors. During this same time period, there were problems with the farm irrigation system that resulted in foreign material being injected into the drip system. This resulted in uneven and unpredictable clogging of the drip tubing. As a result of this combination of setbacks, yields were approximately half typical state yields. Variation in the yield data prevented detection of statistically significant differences across the treatments. In addition, the automatically initiated irrigation treatments used more irrigation water than the manual treatment due to valve failure in the middle of the season.

As a result, a no-cost extension has been requested to repeat the project in 2004.

Student involvement

One Ph.D. student, one master's student, and three undergraduate students assisted in the project.