Title:Demonstration of Low-input Strategies for Potato/Vegetable Production on Irrigated Sands

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Investigators: Byron Shaw, Professor, UW - Stevens Point
David Curwen, Extension Horticulturist, UWEX, Hancock Agricultural Research Station
George Kraft, Director, Central Wisconsin Groundwater Center
Thomas Osborne, Former Director, Central Wisconsin Groundwater Center

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Background/Need: Wisconsin leads the nation in the production of processing vegetables and is sixth nationally in potato production. Most of this production is located in the Central Sands Area where groundwater is susceptible to contamination by nitrate and pesticides due to permeable soils and shallow depths to groundwater. Best management practices (BMPs) have been developed for potato and processing vegetable production on irrigated sands to protect groundwater while maintaining crop profitability. This project was designed to demonstrate the effect of these BMPs on productivity, profitability and groundwater quality.

Objectives: To demonstrate the crop productivity, cost reduction and groundwater quality benefits of BMPs used in potato and process vegetable production in the Wisconsin Central Sands Area.

Methods: Three potato/vegetable growers participated in this project. Growers A and B were located in Portage County in the Central Sands Area while grower C was located in Barron County in northwestern Wisconsin. Each grower provided a 40-acre, center-pivot irrigated field having sandy soils and a relatively shallow ($\leq$ 15 ft.) depth to groundwater. Potatoes were planted in all three fields for the 1988 growing season. In 1989 sweet corn was planted in Field A, snap beans in Field B, and red kidney beans in Field C. A BMP program was used on one-half of each field and the grower's production practices were used on the other half, except for Field C in 1989 where no BMP program was used. Each field was divided into halves along the cardinal direction most parallel to the hydraulic gradient. The BMP programs: 1) minimized nitrogen fertilizer application 2) minimized the use of herbicides, 3) eliminated the use of systemic insecticides on potatoes and snap beans (systemics are not available for sweet corn), 4) used the computer programs PDM (Potato Disease Management) and WMF (White Mold Forecasting) to predict the occurrence of disease in potatoes and snap beans, 5) utilized weekly field scouting to determine the need for controlling disease problems, and 6) used the Wisconsin Irrigation Scheduling Program (WISP) to minimize over-irrigation. Crop productivity and groundwater quality data were collected to evaluate the effectiveness of the BMP programs. Yield and quality determinations were made to determine productivity. Each half of each field was surrounded by three monitoring well nests, one up-gradient and two down-gradient. Each nest had two monitoring wells, one screened from 0 to 3 feet and the other from 4 to 7 feet below the water table. Water quality samples and water level measurements were taken about every two weeks during the growing season and monthly otherwise. Analyses were conducted for temperature, pH, conductivity, nitrate, chloride, alkalinity, hardness and herbicides.

Results: Compared to the grower's programs, BMPs employed in the 1988 demonstrations generally used less fertilizer nitrogen, pesticide and irrigation inputs. These input reductions were made without a significant loss of productivity from Fields B and C. There was some productivity loss from Field A. The 1989 BMP programs were effective in reducing some, but not all production inputs. Field A showed a reduction in sweet corn yield (smaller ear size) associated with the BMP program. Nitrogen and

irrigation inputs were reduced on Field A resulting in a decrease in variable costs and a lower yield. At Field B there was no difference in snap bean yield between the grower and BMP programs though the BMP program resulted in a smaller pod size. Per unit costs were not determined either year due to lack of total cost data for the grower program. Substantial amounts of nitrate were lost to groundwater from both grower and BMP practices resulting in groundwater nitrate concentrations substantially exceeding the 10 mg/L groundwater standard. The BMP programs were not effective in reducing nitrate leaching. Nitrate was lower in up-gradient wells than in down-gradient wells. Nitrate was lower in shallow up-gradient wells than deeper up-gradient wells. BMP shallow wells were higher than the grower's programs in nitrate during both years in Fields A and B. There were five herbicide detects, all in 1988, four of which were found down-gradient of BMP program fields and one which was found in an up-gradient well.

Conclusions: Though probably affected by the climactic stresses of the 1988 growing season, the BMP program's potato productivity loss was likely a result of poor weed control. For snap beans and sweet corn grown in 1989, BMPs were effective in a limited reduction of some production inputs. Little yield reduction was observed. Per unit costs were not determined due to lack of total cost data for the grower program. Surprisingly, concentrations of nitrate found down-gradient of the BMP programs exceeded that found down-gradient of the growers programs fields. Interpreting groundwater data was difficult due to uncertainty as to what the monitoring points were actually sampling; water recharged during the previous year, the present year or a mixture of both. A better approach is needed.

Recommendations/Implications: Investigators recommend defining the vertical thickness of groundwater containing the current year's recharge water and leached nitrate by use of multi-level samplers. Samples from each level could be analyzed for specific indicators to delineate the current year's recharge. Several possible indicators are suggested.

Related Publications:

Osborne, T., D. Curwen and B.H. Shaw. 1990 Quantifying Groundwater Quality and Productivity Effects of Agricultural Best Management Practices on Irrigated Sands, Proceedings of Symposium on Agricultural Impacts on Groundwater Quality. NWWA Groundwater Management Vol.1, pp. 129-143.

Key Words: Best management practices, nitrate, Central Sands.

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Project Report: A report on this project is available for loan from Wisconsin’s Water Library, University of Wisconsin - Madison, 1975 Willow Drive, Madison, Wisconsin 53706.