Report for 2000WA4G: Integration of Surface Irrigation Techniques to Reduce Sediment and Nutrient Loading in the Yakima River Basin

- Water Resources Research Institute Reports:
  - Leib, Brian G. and Robert G. Stevens, 2003, Integration of Surface Irrigation Techniques to Reduce Sediment and Nutrient Loading in the Yakima River Basin, State of Washington Water Research Center, Washington State University, Pullman, Washington, State of Washington Water Research Center Report WRR-17, 6 pages.
- Conference Proceedings:
  - Leib, Brian G., Robert G. Stevens, and Cristoti A. Redulla, 2002, Integration of surface irrigation techniques to reduce sediment loading in the Yakima River Basin of Washington, USA, "in" Proceedings of the International Workshop on Conservation Agriculture for Wheat and Cotton Production in Limited Water Resource Areas, Tashkent, Uzbekistan, October 13 18, 2002. Paper available at http://siip.prosser.wsu.edu/uzbek_2002.pdf
  - Leib, Brian G., Robert G. Stevens, Cristoti A. Redulla, Gary R. Matthews, and David A. Strausz, 2002, Integration of surface irrigation techniques to reduce sediment and nutrient loading in the Yakima River Basin, "in" Proceedings, Biennial Conference on Agriculture and Water Quality in the Pacific Northwest 2002, Yakima, Washington, November 19 - 20, 2002, p. 15.
- Other Publications:
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  - Thomas, J. and B.G. Leib. 2001. Protecting Beneficial Uses of Water in 2001. Poster for the Yakima USGS-NAWQA Liaison Committee Meeting. May 2001.
  - Leib, Brian G., 2001, Reducing erosion in rill irrigated concords, Presentation at the Washington State Grape Society Annual Meeting, Grandview, Washington, November 29, 2001.
  - Leib, Brian G., 2001, Reducing erosion in rill irrigated row crops, Presentation at the Pacific Northwest Vegetable Association - Annual Convention, November 29, 2001.
  - Leib, Brian G., 2002, Improving return flow water quality from furrow irrigation, Presentation at the Columbia Basin Crop Consultants Association Shortcourse, Moses Lake, Washington, January 16, 2002.
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  - Leib, Brian G., Cristoti A. Redulla, Robert G. Stevens, Gary R. Matthews, and Davis A. strausz, 2004, Integration of erosion control practices to reduce sediment loads in furrow irrigation, Presentation at the 2004 ASAE/CSAE Annual International Meeting, Ottawa, Ontario, Canada, August 1-4, 2004, Paper No. 042041.

Report Follows

Problem and research objectives

Surface (rill) irrigation has been identified as one of the main sources of excess sediment in the Yakima River Basin. In turn, it is this source of water quality degradation that is thought to be one of the causes for declining salmon runs in the Yakima River. The Washington Department of Ecology has set a sediment limit for irrigation return flows of 25 NTUs (56 mg/l). Some irrigators are converting their rill irrigation systems to either sprinklers or drip irrigation at a cost of $300 to $1000 per acre. In some cases, this large capital investment in improved irrigation systems is being offset by cost share and low interest loan programs. However, there is not enough cost share money to match the rill acreage and many irrigators cannot afford to convert their irrigation systems even if cost share were available to everyone. Therefore, many rill irrigators are attempting to improve their existing systems in order to keep their operations as profitable as possible. Many rill irrigators are applying Polyacrylamide (PAM) and successfully decreasing sediment loads from furrows by 80 to 90 percent. Unfortunately, this cleaner water often erodes sediment from the tailwater ditch causing elevated NTU levels still too high to be returned to irrigation district canals and drainage ditches. The focus of this research will be on inexpensive methods to further reduce sediment and nutrient loads from rill irrigation. Sediment loads will be evaluated for PAM ($20/ac per year) used with Surge irrigation ($125/ac), tailwater drains ($75/ac), tailwater checks ($25/ac), and grass-lined tail ditches ($25/ac).

Methodology

The five treatments are: Treatment 1) PAM alone as the control, Treatment 2) PAM and Surge irrigation, Treatment 3) PAM and closely spaced surface drains in the tailwater ditch, Treatment 4) PAM with a grass-lined tailwater ditch, and Treatment 5) PAM and tailwater checks. The treatments are being repeated at two locations during two growing seasons to create four replicates with significant field and year effects. Also, data collection will be repeated during each irrigation event (the number of irrigations are dependent on the crop and soil type). The treatments need to be large enough to allow approximately 50 furrows to flow into the tailwater ditch at one time. The treatments will be randomized within each field in each year.

Each treatment is being monitored for inflow, outflow, soil moisture, sediment load, and sediment concentration. Measured inflow to the furrows is important to insure that all treatments are subjected to the same erosive force. Inflows will be estimated by measuring the delivery pipe and percent opening of spigot valves that will be rated in the set-up. By comparing total inflow to total outflow, the proportion of water lost via run-off can be determined along with the average application depth. Outflow from each treatment will be measured by a flow meter that receives water from a collection sump and sump pump at a maximum rate of 2.0 gallons per minute per furrow.

Soil moisture will be monitored with the neutron probe and access tubes. There will be readings before and after each irrigation. Treatment will have two access tubes at both the head and tail of the field for a total of six tubes. This type of monitoring will help determine the timing of irrigations and the uniformity/depth of application. Average advance time will also be recorded.

Composite samples will be collected from every irrigation runoff event. Samples will be taken as water falls into the tailwater sumps. Samples will be kept at 4 ^{o}C until chemical analyses. All

water quality analyses will be performed using EPA methods (U.S. EPA, 1983). Soluble compounds will be determined in samples filtered with a 0.45μm pore-size membrane and analyzed for ammonium-nitrogen, nitrate-nitrogen, and soluble reactive phosphorus. Unfiltered samples will be analyzed for total Kjeldahl nitrogen, and total phosphorus. All forms of nitrogen and phosphorus will be determined by automated analysis.

After outflow is measured, the tailwater effluent will be delivered to a sediment trapping box. The slotted apple crates will be lined with filter fabric to retain sediment. The number of boxes will be large enough to trap a season's worth of sediment if the tailwater contains 1000 mg/l of sediment. The depth of sediment added to the boxes will be measured after each irrigation. Also, NTUs and suspended solids will be measured at periodic intervals during tailwater run-off to determine whether return flow water-quality standards are being met.

PAM will be applied to all the furrows just below the point of water delivery and at the time when the furrow soil has been disturbed by field operations. Similarly, all other cultural practices such as weed control and fertilization will be held constant between treatments according to standard production practices.

Principal findings and significance

Since 2001 will be the first field season for this project, there are no experimental findings at this time. The accomplishments to date are:

1. Formed a project management/oversight team comprised of members from a cross section of Tribal Offices and Government Agencies (see Information Transfer Section above).
2. Arranged for "on-farm" experiments/demonstrations on two cooperating farms. Colin Mears and Billy Korstad in the Wapato Irrigation District will be cooperating on a 40-acre, rill irrigated, grain corn field with 1300 foot runs and a 0.2% slope on the tailwater ditch. Ken Lewis of the Roza Irrigation District will be cooperating on a 30-acre, rill irrigated, Concord grape field with 800 foot runs and a 1.2% slope on the tail water ditch.
3. Personnel to conduct the field project have been hired. In addition to the students identified in the section above, Gary Matthews, Engineering Technician, has been retained to fabricate, install and maintain the monitoring equipment needed for this experiment.
4. Most of the materials and equipment needed to conduct the experiments have been purchased and/or fabricated. Once the cooperating producers form the tailwater ditches in their fields, the monitoring equipment will be installed and data collection will commence.
5. The Washington State University Water Quality and Waste Analysis Lab will be performing the certified analysis of water samples and a quality assurance program for the sampling protocol is being finalized.