REDUCTION OF IRRIGATION-INDUCED LOSS OF *E. COLI* FROM SURFACE-IRRIGATED PASTURES

Clinton C. Shock, Richard Griffin, Brian Noble,
Cedric Shock, and Kathy Pratt
Malheur Experiment Station
Oregon State University
Ontario, OR, 2003

Introduction

Willowcreek is a tributary of the Malheur River, which has its confluence at Vale, Oregon. At the time of Fremont's exploration in 1842 of what would become the Oregon Trail, he took the "Dry Fork" of the Malheur River north, then crossed over the hills to the Snake River to the place that would become known as Farewell Bend. The "Dry Fork" became known as Willowcreek. A photograph from 1907 shows the narrow riparian ribbon from Willowcreek exiting from its valley dominated by sage brush to the Malheur River. Through the decades that followed, pioneers impounded the snow melt runoff in the Willowcreek drainage and used the impounded water for mining and later to irrigate pasture and crops. Runoff from irrigated land sustains the sluggish flow of Willowcreek during the summer.

In recent years ranchers and growers have been concerned with the levels of *E. coli* bacteria in Willowcreek and have sought various methods to reduce the bacterial content. In the present effort, aeration and polyacrylamide (PAM) were used to try to reduce the losses of bacteria from irrigated pastures.

Objectives

1. Evaluate the effect of PAM on the reduction of *E. coli* loss from flood-irrigated pasture.
2. Determine if the PAM application rate can be reduced and still be effective when applied only to the lower 20 percent of the water run.
3. Evaluate whether aeration will reduce irrigation-induced *E. coli* losses.

Materials and Methods

Strips through a pasture on Owyhee silt loam at the Malheur Experiment Station were evaluated for *E. coli* loss during successive 12-hour irrigations. Irrigations were managed to apply approximately 4 acre-inch/acre of water per irrigation. Each strip was 19.7 ft wide (6 m) by 164 ft long (50 m). Treatments included an untreated check, powdered PAM (Soilfix IR, Ciba Specialty Chemicals, Inc., Suffolk, VA) applied in the irrigation water; aeration; and PAM applied to only the bottom of the field (Table 1).

Each treatment was replicated three times in the field with separate strips. Each strip was evaluated for *E. coli* loss through three successive irrigations.

Grazing occurred over the pasture land before each irrigation. During each irrigation, the amount of water applied and in the runoff was measured repeatedly in each plot on hourly to half-hourly time intervals. Water running into each strip was measured with three weirs and the outflow was measured with one weir, so the set-up of each irrigation required 16 weirs, four for each treatment. The water was sampled until runoff ended. Although the irrigations were nominally 12 hours, the actual times of irrigation onset and ending were recorded as well as the actual time and ending of water outflow. At each sampling time, a water sample was collected for *E. coli* analyses and transported to the Bureau of Reclamation laboratory in Boise within 24 hours of sampling.

The loss of *E. coli* was calculated by determining the volume of water and *E. coli* content entering each irrigated strip as integrated over time and determining the volume of water and *E. coli* content of the water leaving each irrigated strip as integrated over time. The software program Infilcal version 5.0 (B.M. Shock and C.C. Shock, Ontario, OR, self-published: version 2.0, 1988; version 5.0, 1992) was modified to take the weir readings and timings and calculate the water into and out of each strip during each irrigation. Infilcal also was modified to calculate the total *E. coli* into and out of the pasture strip. Treatment losses of *E. coli* were compared using ANOVA and standard statistical procedures.

Table 1. Treatments for studying *E. coli* losses from surface-irrigated pasture, Malheur Experiment Station, Oregon State University, Ontario, OR, 2003.

Treatment #	PAM	Aeration
1 untreated check	none	none
2	Treated water, 10 ppm, applying 1 lb/acre	none
3	Granular, broadcast at 1 lb/acre on the bottom 20 %	none
4	none	mechanical

Results

Each set of pasture strips was irrigated four times, rather than three as originally planned. During the first irrigations problems occurred that compromised the accuracy of the measurements. Berms between irrigated strips, uniformity of irrigation, and the sensitivity of laboratory analyses all had to be improved. Consequently the project required more effort in irrigation, *E. coli* analyses, and statistical analyses than originally expected. In total approximately 2,000 inflow, 400 outflow, and 1,000 *E. coli* measurements were made.

During the subsequent nine irrigations, three each on three sets of four pasture strips, the irrigations were well managed and all data were recovered as planned. Each irrigation applied about 4 acre-inch/acre (Table 2). There were no statistically significant differences in water applied, infiltration, or runoff between treatments. This means that neither the PAM nor the aeration improved water retention in the pasture. During each irrigation roughly 80 percent of the water soaked into the pasture strip and 20 percent ran off.

The treatments had no significant effect on the average or total *E. coli* lost in the runoff water (Table 2). The predominant factor was the vast and unexpectedly large *E. coli* enrichment that occurred as the water crossed the sloping pasture ground. The variations in enrichment swamped out any possible measurable effects of the treatments.

Table 2. Average effects of the use of PAM and aeration on irrigation performance, *E. coli* concentrations and *E. coli* losses, Malheur Experiment Station, Oregon State University, Ontario, OR, 2003.

	Average irrigation performance			Average *E. coli* counts and losses per irrigation		
Treatment	Inflow	Outflow	Infiltration	Counts in	Counts out	Loss in counts/acre
	--------- acre-inch/acre---------			counts/100 ml		billions
1. Check	3.98	0.63	3.35	4,261	235,605	161
2. PAM	3.89	0.74	3.15	4,466	420,142	317
3. Granular PAM	3.89	0.68	3.21	5,072	363,045	241
4. Aeration	4.07	0.85	3.22	5,274	220,016	302
LSD (0.05)	NS	NS	NS	NS	NS	NS

Discussion

Control of *E. coli* losses from surface-irrigated pasture was not easy to obtain in the current test. The results of this preliminary trial suggest that solutions to *E. coli* losses from sloping ground may lie in other directions or with the use of higher rates of PAM. The PAM rate sufficient to slow or stop *E. coli* loss from sloping surface-irrigated pastures is unknown. Perhaps PAM could reduce *E. coli* loss when used on nearly flat surface-irrigated pastures, conditions not tested in the present study.

Water that is used for surface irrigation of pastures needs to have opportunities for bacteria to settle out of the water. Water exiting a steep surface-irrigated pasture like the one used here may need to enter a settlement pond and be pumped back to the top of another pasture or be pumped into a sprinkler-irrigation system to minimize water runoff losses, thereby precluding *E. coli* losses to streams.

Acknowledgments

This grant was supported through an Oregon Watershed Enhancement Board grant to the Malheur County Soil and Water Conservation District in close cooperation with the Lower Willowcreek Working Group. This work would have been impossible without the dedicated efforts of the Bureau of Reclamation laboratory in Boise.