USE OF POLYACRYLAMIDE TO CONTROL EROSION IN FURROW IRRIGATED FIELDS

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Furrow irrigated fields can experience high levels of soil erosion, particularly on sloping lands and with silt loam textures. Erosion has significantly reduced soil productivity in areas of southern Idaho. The sediment carried off in tailwater represents a major non-point source for water quality degradation. USDA-ARS researchers at Kimberly, Idaho, have pioneered the use of low concentrations of polyacrylamide (PAM) in irrigation water to reduce soil erosion and sediment delivery. Based on their promising results, we conducted field-scale on-farm tests of PAM in Grant County, Wa., during 1994 to determine how the product worked here and whether it was feasible for growers to use at the farm scale.

The PAM product tested is a water soluble, high molecular weight, anionic material widely used in wastewater treatment, oil drilling, and other industrial processes (Magnifloc A-836, CYTEC Industries, Stamford, CT). Similar products are available from other manufacturers (e.g. Allied Colloids). Cost is approximately $4.50 per pound. The PAM was delivered in a dry crystalline form, and then dissolved in water to create a stock solution of 0.25% PAM. Viscosity increases geometrically with concentration, and the 0.25% concentration flowed easily enough to accurately meter.

Field tests were conducted on a bean field north of Othello, WA, and a grain corn field west of Othello. At both sites, a section of gated pipe was installed parallel to the existing delivery system so that PAM treated water could be delivered to replicated plots independent from the untreated water system. Each site had three replications, with plots containing four furrows and running the length of the field. In each plot, a packed (wheel-track) furrow and unpacked furrow was monitored for flow and sediment concentration (using an Imhoff cone).

The bean field trial was discontinued after the third irrigation due to lateral cutting across furrows that contaminated the plots. Plant height at maturity and grain yield were measured on the corn field. All results reported below refer to the corn field trial.

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The trial began on the first irrigation after the final row cultivation, and PAM was applied for 7 consecutive irrigations. The PAM stock solution was metered into the gated pipe to achieve a final concentration of 10 ppm PAM in the water entering the furrows. The PAM injection began when the water was turned on and continued until the majority of the furrows had water to the end of the field. This resulted in approximately 1.0-1.5 lb PAM being applied per acre per irrigation.

Sediment loss was significantly lower in the PAM treated plots for the first and second irrigations (Fig. 1). Throughout the trial, the packed furrows experienced higher sediment loss than the unpacked furrows, and tended to have faster advance times, especially during the first few irrigations. The PAM treated unpacked furrows experienced virtually no sediment loss during the 7 irrigations compared to a loss of over 8 tons/acre for the untreated packed furrows during the first irrigation alone. Sediment loss was greatest during the early hours of irrigation and tapered off as the easily detached soil was removed (Fig. 2).

We noticed that the PAM treated furrows did keep their original V shape through the season and therefore held the water stream much higher than in those furrows that were eroding and cutting. This tended to lead to better lateral wetting from the PAM treated furrows. This may lead to more uniform soil moisture and improved yields on fields with wetting problems, especially slopes. The test field has a slope of 7-10% on the lower half. Also, the slower advance times with PAM during the first few irrigations, especially for the unpacked furrows, indicated increased water infiltration and potential for water conservation. The PAM exacerbated the difference between packed and unpacked furrows in terms of advance time, and management practices to make the field all packed or unpacked may be needed to maximize the potential of PAM.

At harvest, there were no differences in plant height on the treated and untreated plots, although the grower was able to observe distinct strips when looking at the field from a nearby hill. Corn yield increased an average of 0.41 tons/acre on the PAM treated plots, but this was not statistically significant (Table 1).

From a grower logistical standpoint, mixing the stock solution required a good stirring mechanism and some experience. We used a device called a "Hottenany" to add the dry PAM to water and this helped to avoid forming gelatinous clumps that do not dissolve. A battery box was used to meter the PAM into the system and worked well. The main drawback for the stock solution approach is the large volumes needed to treat an average size field. Thus, growers are considering techniques for adding the dry PAM directly into their irrigation delivery system.

Our results in 1994 were very consistent with those from Idaho and Oregon. The PAM treatment reduced sediment loss by over 95% and increased water infiltration. The technology is feasible for growers to use, and may cost in the range of $15-25 per acre per year depending on the crop. More testing is needed of dry PAM application techniques. The WA Dept. Of Ecology has given approval for PAM use on irrigated fields and would like to conduct some aquatic assessments.

Overall, PAM appears to be a very promising tool to add to a water management program that can improve crop production and protect our natural resources at the same time.

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Figure 1. Total sediment loss with and without PAM treatment on a furrow irrigated corn field (Othello, WA - 1994).

P,W = PAM treated, packed furrow; P,NW = PAM treated unpacked furrow; NP,W = no PAM, packed furrow; NP,NW = no PAM, unpacked furrow

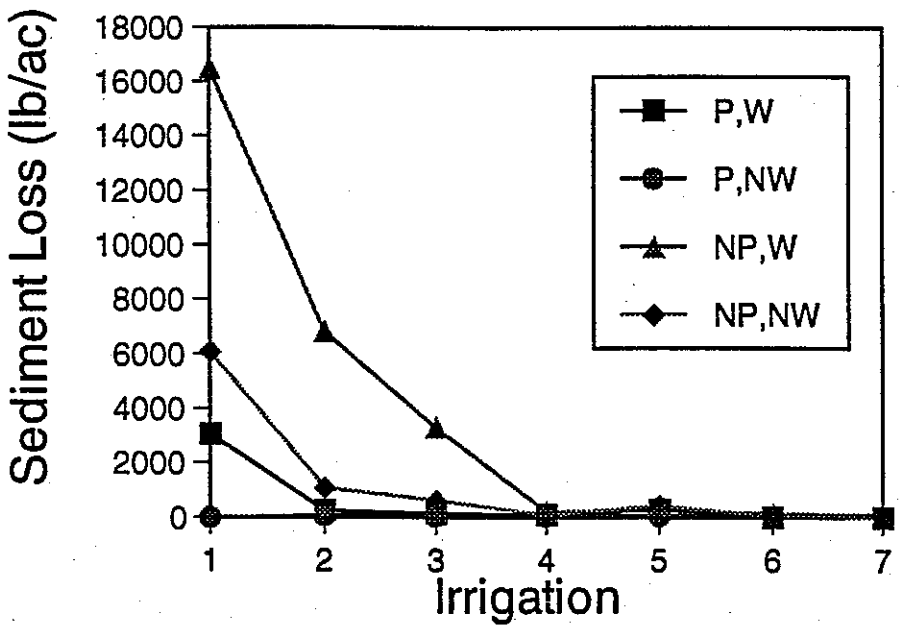

Figure 2. Cumulative sediment loss during the first irrigation after row cultivation (Othello, WA - 1994.

P,W - PAM treated, packed furrow; P,NW = PAM treated, unpacked furrow; NP,W = no PAM, paked furrow; NP,NW = no PAM, unpacked furrow

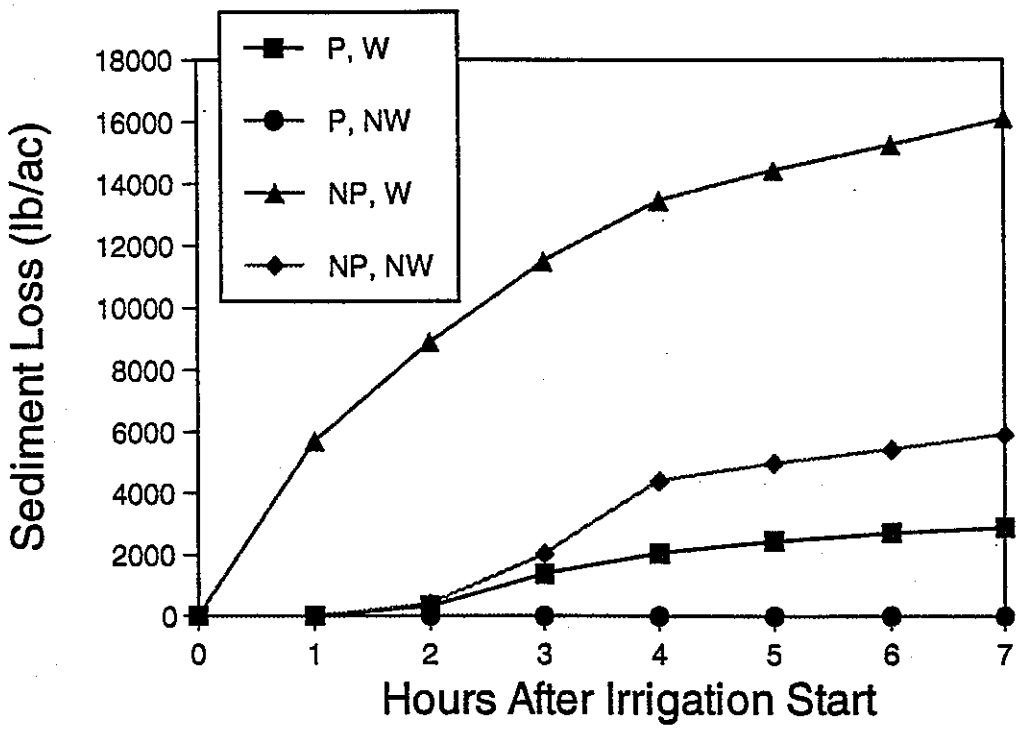

Table 1. Effect of PAM on corn grain yield - Othello, WA 1994.

	Corn Grain Yield (tons/acre)			
	Replication			
Treatment	1	2	3	Mean
PAM	4.40	3.37	5.86	4.54 a
No PAM	3.86	4.17	4.37	4.13 a
(C.V.=19%)				