EFFECTS OF POLYACRYLAMIDE APPLICATION METHOD ON SOIL EROSION AND WATER INFILTRATION

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Abstract

In late June 1995, a study was conducted on a Teramura Farms' furrow-irrigated onion field to compare the effectiveness of two different application methods of polyacrylamide (PAM) to irrigation water in reducing soil loss and increasing infiltration. Water applied to individual furrows was treated with dissolved PAM, granular PAM, or left untreated.

The study showed that both PAM application methods reduced sediment loss and increased water infiltration. Granular PAM was highly effective at reducing sediment loss.

Introduction

Irrigation induced soil erosion is a serious problem on furrow irrigated agricultural land in the western United States. Growers lose money long term from soil erosion because the topsoil has been washed off, making the land less productive and crops less profitable.

Polyacrylamide (PAM) applied to the irrigation water in small quantities has been shown to decrease the amount of sediment loss, as well as increase water infiltration into the soil in furrow-irrigated fields (Trout et. al. 1993, Shock et. al. 1994). Polyacrylamide is a slightly water-soluble, high molecular weight, long chain polymer, that flocculates suspended soil particles.

Polyacrylamide was first marketed 30 years ago as a product named Krillium. Krillium was deemed uneconomical because of the large quantities needed to adequately treat the soil.

In 1994, five Malheur County growers experimented with liquid PAM and in 1995 dozens of growers used the more easily transported and more conveniently handled granular form, without knowing how well it would perform to reduce soil loss and enhance water infiltration. This experiment was conducted to compare granular PAM with liquid PAM with regards to sediment loss and water infiltration. Furthermore granular PAM had been criticized for water application because it dissolves slowly. We wanted to determine if granular PAM could be as effective at reducing erosion in

furrows when applied starting at the beginning of the head ditch (where it has not yet thoroughly dissolved) as when applied to the furrows further down the head ditch.

Procedures

This experiment was conducted on 18 measured furrows of a 7 acre Teramura Farm onion field following a mid-season cultivation. The water used to irrigate each of three sets of the six measured furrows either received dissolved (liquid) PAM, granular PAM, or no treatment, the check (Figure 1).

The plot layout compared if PAM was as effective further down the head ditch of the field as at the beginning (Figure 1). The plot layout skipped 90 furrows in the center of the field. Furrows were approximately 40 inches apart and 600 feet long. The soil was Owyhee silt loam (Coarse-silty, mixed, mesic Xerollic Camborthid) Sweet Spanish onions, cultivar Vega, were planted on March 24, 1995. The 7.5 acre field had a slope of 1.4 percent (0.8 degrees) (Figure 1). Both liquid and granular PAM were to be applied at 1 lb/ac during the first 4 hours of a 24 hour irrigation set. Due to water flow changes in the head ditch, the actual rate of the liquid PAM application was 0.9 lb/ac and the actual rate of granular PAM was 1.8 lb/ac. All furrows were irrigated using siphon tubes. The average irrigation duration was 22 hours and 52 minutes and the average irrigation rate was 2.89 gallons per minute in each furrow. The PAM used was finely ground, had molecular weight of 15-18,000,000 daltons and was 30 percent anionic (Soil Saver, Aqua II, Rupert, Idaho).

Water inflow rates were determined by timing how long the water coming out of the siphon tube took to fill a 0.975 liter can. Inflow rates were taken at hourly intervals. Outflow was determined with use of a Powlus V flume which was inserted into the outlet end of the furrow and read by a gauge on the flume's side. The outflow readings were taken at hourly intervals. Sediment loss measurements were taken in conjunction with the outflow readings by means of Imhoff cones in which runoff irrigation water was placed and read by means of a gauge on the side. Imhoff cone readings after 15 minutes of settling had been previously related to sediment loss by the equation $y=1.015x$ where y is the grams of soil lost in each liter of water washing of the field at any given moment of time and x is the Imhoff cone reading. Inflow, outflow, and sediment loss data were entered and converted in a number of different computer programs to calculate the data for this report.

Results and Discussion

The results for sediment loss were clear and pronounced. Check furrows lost 322 lb/ac of sediment off of the field in a single irrigation. Furrows irrigated with granular PAM lost 7 lb/ac of sediment off of the field, while those irrigated with the liquid solution of PAM lost 104 lb/ac in the runoff water (Figure 2). During the irrigation the two PAM treatments showed a difference in soil erosion, but recall that the granular PAM was applied at twice the rate of the liquid PAM. The difference in PAM rates was not

intentional, but caused by changes in volume of water flowing in the head ditch during the experiment caused by other changes in irrigation management on the farm.

Infiltration tended to increase by both PAM application methods, but did not reach statistical significance. Out of the total water applied treated with granular PAM, 73.3 percent of the water infiltrated into the soil and 26.5 percent was lost as runoff. Out of the total water treated with liquid PAM, 70.8 percent of the water infiltrated and 29.1 percent was lost as runoff. In the check furrows 62.5 percent of the total water applied infiltrated and 37.5 percent of the water was lost as runoff (Figure 3). Granular PAM was as effective in stopping loss of sediment in the first furrows as in the last (Figure 4)

Polyacrylamide costs about $4.50 a pound, so use during an entire season following cultivations increases costs moderately. Irrigation using PAM requires added maintenance as the siphon tubes tend to clog with coagulated soil. The rate of PAM has to be monitored carefully and the measurements must be accurate. The added costs and maintenance required when PAM is used could be offset financially in the short term by increased onion yield and quality if the crop suffers less water stress when irrigated with PAM. The use of PAM appears to stabilize furrow shape, providing growers with a potential immediate benefit in reduced cultivation costs. Polyacrylamide may be profitable to growers who use it, as they may not have to irrigate as often or for as long due to increased infiltration. With improved water infiltration, onions may suffer less water stress and be more productive, but this experiment was not designed to measure onion responses to irrigation management options.

Conclusion

Polyacrylamide is an effective soil erosion control chemical. The convenient granular form worked effectively in an on farm trial. This study shows that the granular PAM can be highly effective at controlling soil erosion. The water treated with liquid PAM or granular PAM had infiltration rates that were slightly higher than untreated water, but the differences in infiltration were not statistically significant.

Literature Cited

Trout, T.J., R.E. Sojka, and R.D. Lentz. 1993. Polyacrylamide effect on furrow erosion and infiltration, American Society of Agricultural Engineers, Spokane, Washington.

Shock, C.C., J. Zattiero, K. Kantola, and L.D. Saunders. 1994. Comparative cost and effectiveness of polyacrylamide and straw mulch on sediment loss from furrow irrigated potatoes, Oregon state University Agricultural Experiment Station Special Report 947:128-137.

Figure 1. Plot layout for testing granular and liquid PAM at a Teramura Farms onion field. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1995.

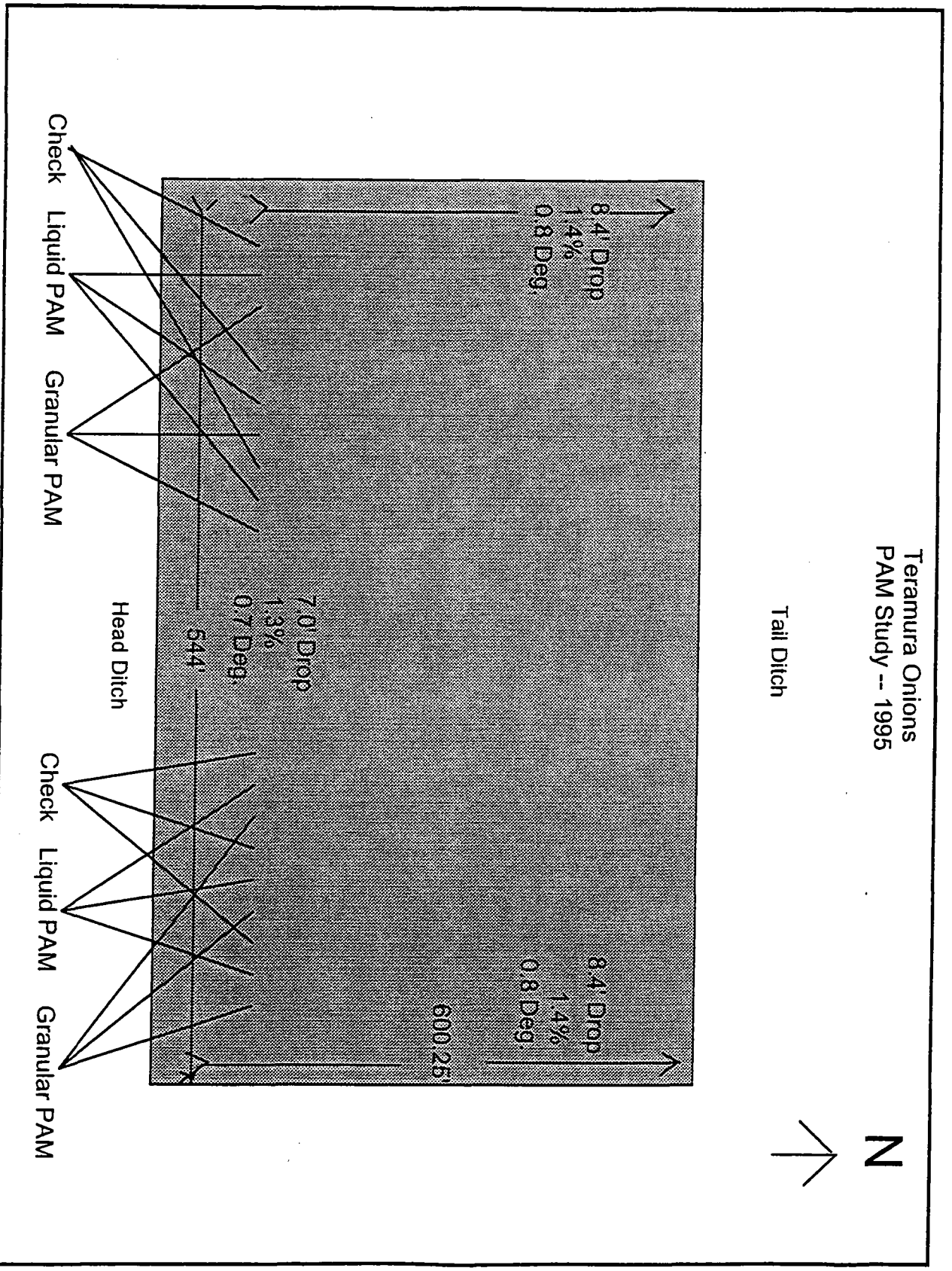

Figure 2. Effects of liquid PAM at 0.9 lb/ac and granular PAM at 1.8 lb/ac on sediment loss from furrow irrigated onions (LSD (0.05) = 233 lb/ac). Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1995.

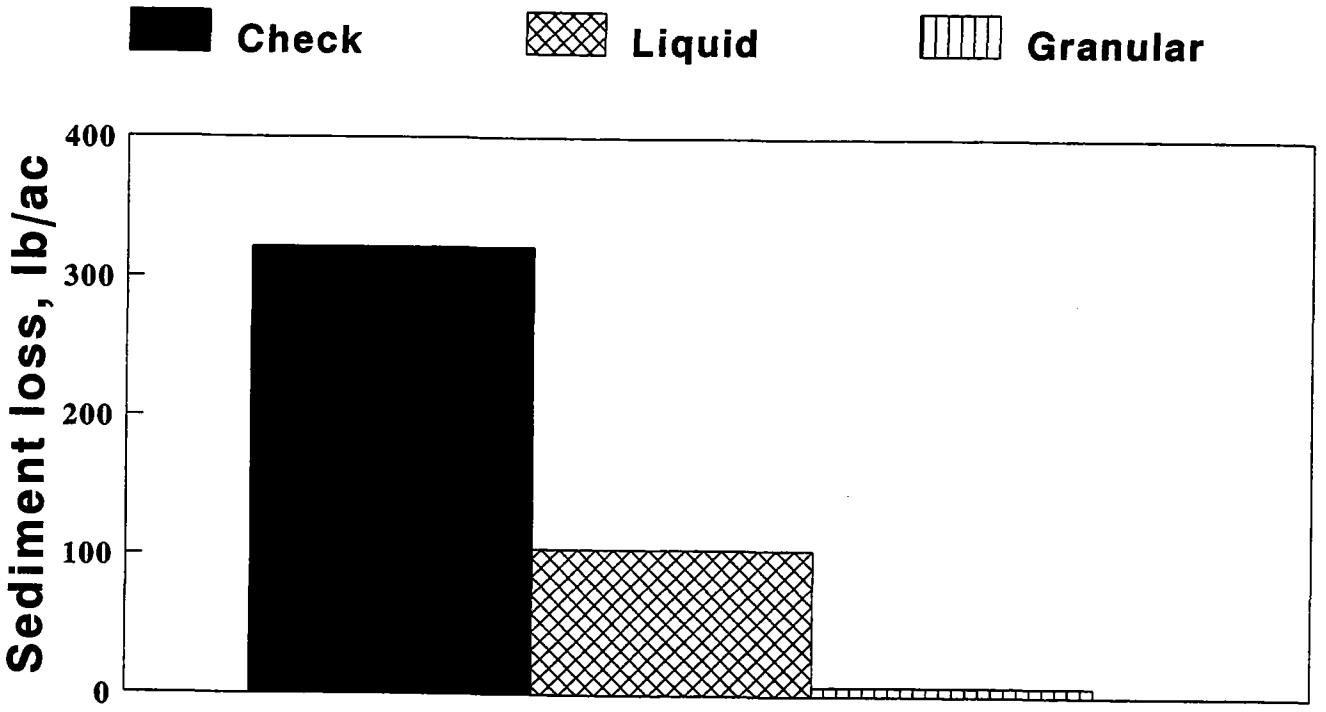

Figure 3. Effect of liquid PAM at 0.9 lb/ac and granular PAM on the water infiltration and runoff as a percent of water applied. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1995.

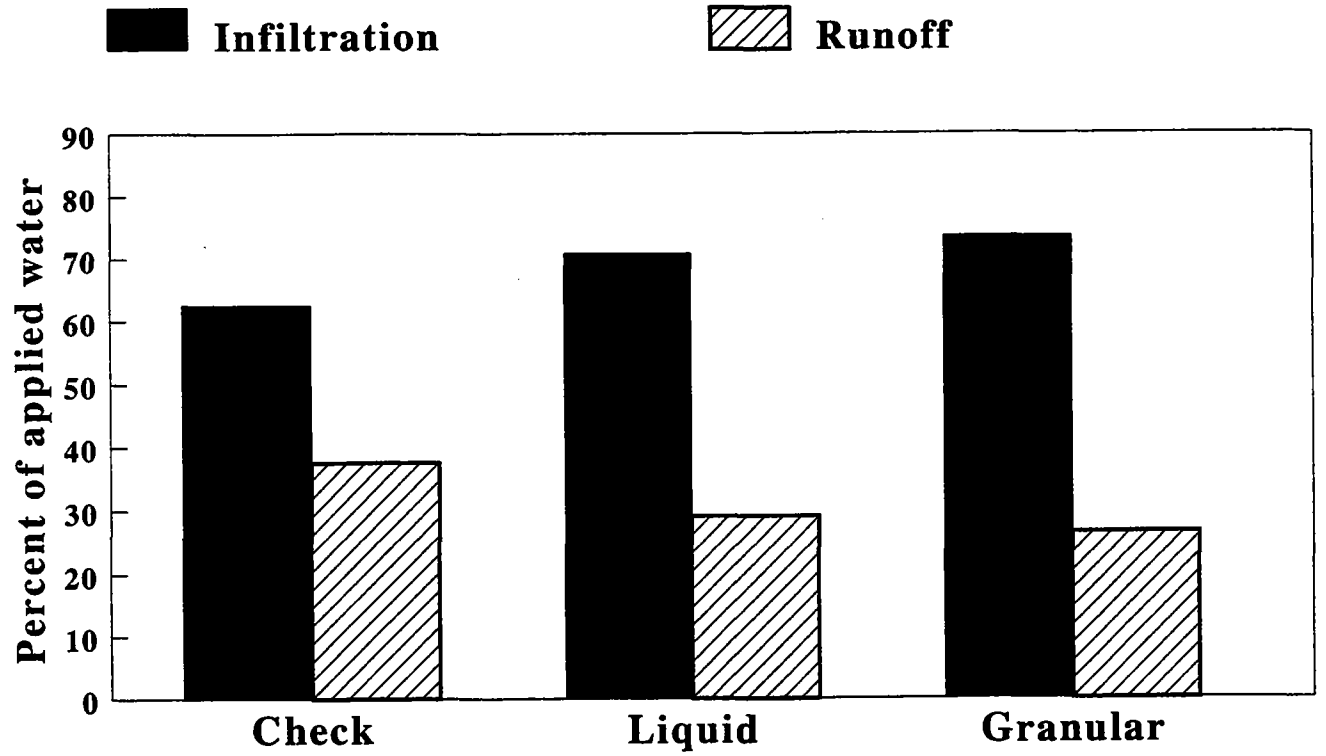

Figure 4. Effect of liquid PAM at 0.9 lb/ac and granular PAM at 1.8 lb/ac on the sediment loss as a function of distance from PAM dispenser. Malheur Experiment Station, Oregon State University, 1995.