PAM AND/OR LOW RATES OF STRAW FURROW MULCHING TO REDUCE SOIL EROSION AND INCREASE WATER INFILTRATION IN A FURROW IRRIGATED FIELD, 1995 TRIAL

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Summary

Polyacrylamide (PAM) and straw mulch were tested to measure reduction of soil erosion and increases in water infiltration in furrow irrigated onions. PAM was applied at a rate of 1 lb/ac and straw was applied at 150 lbs/ac. During a single irrigation, following cultivation, the untreated furrows lost 0.93 tons/ac of soil. The straw mulched furrows lost 0.62 tons/ac. The furrows irrigated with water treated with PAM lost 0.36 tons/ac of soil. Furrows with PAM plus straw mulch plots lost 0.08 tons/ac. Straw mulching 150 lb/ac decreased the amount of sediment loss by 33 percent ($P = 0.17$). PAM decreased the amount of sediment loss by 61 percent. The combination of PAM and straw mulch decreased the amount of sediment loss by 91 percent over nonmulched furrows without PAM.

During the irrigation, straw mulching increased water infiltration from 42 to 45 percent of applied water. PAM alone had little effect on the percent infiltration in this trial. PAM combined with straw mulch increased infiltration from 42 to 56 percent of applied water.

Introduction

Polyacrylamide (PAM), is a long chain polymer. It is used as a flocculating agent in several industrial processes, including the reduction of soil erosion during the irrigation of row crops. Polyacrylamide binds the soil together making it more difficult for water to break off soil particles; it also acts as an agent to settle already suspended soil particles. It gathers and carries sediment to the bottom of the furrow, instead of off the field.

PAM was marketed to treat the tilled soil layer, but due to the large quantities required, the product was considered uneconomical. Recent laboratory studies using new products and application techniques have shown PAM can be used in small quantities to increase soil infiltration rates and reduce erosion (Shock, et. al., 1994; Trout, et. al. 1993).

Mechanically applied straw mulch has been used to reduce erosion and increase water infiltration in Malheur County for 11 years. Manual straw mulching is very laborious and

time consuming, but the mulching machines on the market work effectively. Straw mulch is applied mechanically to the bottom of the furrow, where it impedes the progress of the water. By slowing the water, erosion is reduced and the larger wetted area in the furrow bottom improves infiltration.

The purpose of this experiment is to compare low rate of straw mulch to PAM in erosion prevention and infiltration. The products individually were also compared to the combined application of application of straw mulch plus PAM.

The distance between the source of the PAM and the PAM's effectiveness in preventing erosion was also examined.

Procedures

The experiment was conducted in twenty tractor passes of Vernon Nakada's onion field on Morgan Ave., Ontario, Oregon. Each plot consisted of three furrows, 42 inches apart and 466 feet long. The Owyhee silt loam had a 2.12 percent slope (1.22 degrees) (Figure 1). Cashe yellow onions were planted on April 9, 1995. Five plots were left untreated, five were strawed by hand at an approximate rate of 150 lb/ac, five had liquid PAM applied at a rate of 1 lb/ac in the irrigation water, and five received both PAM and straw (Table 1). The PAM was applied during the first hours of the 24-hour irrigation set. The field was furrow-irrigated by siphon tubes. Inflow, outflow, and soil loss data were collected during the fourth irrigation following cultivation.

Inflow readings were taken at approximately thirty minute intervals, by measuring the amount of time it took for the siphon pipe to fill a 2.56 L bucket. Outflow readings were taken at approximately one hour intervals, with the use of Powlus V Flumes.

The liquid PAM was added to the irrigation water as it entered the head ditch and mixed by water turbulence in the ditch. The PAM plots were irrigated during the first irrigation set and the non-PAM plots were irrigated the next day.

Onset of water inflow and water outflow, and measurements of water inflow rate, water outflow rate and sediment yield were recorded during the irrigation. For each water outflow rate reading, a 1-liter sample of runoff water was placed in an Imhoff cone and allowed to settle for fifteen minutes before being read for sediment content.

The minimum distance between the source of the PAM and a measured furrow was 29 ft, the maximum distance was 123 ft, 7 in.

Total inflow, outflow, infiltration, and sediment loss were integrated from field measurements using a Lotus Improv program "InfilCal 5.0" (Shock and Shock 1993).

Results

Water treated with PAM had a significantly decreased sediment loss (Table 2, Figures 2-5). The relatively small benefits obtained with straw mulch in reducing erosion were not surprising given the very low application rate, 150 lb/ac. Straw application rates are commonly 600 to 800 lb/ac. Straw increased infiltration by 24 mm from 69 to 93 mm. Pam increased infiltration by 19 mm from 69 to 88 mm. The interaction of PAM and straw did not significantly reduce soil loss, a fact that may have been caused by experimental error due to a larger amount of variation among the furrows as is apparent in Tables 3 and 4, but came close to causing a significant increase in the infiltration.

The distance from the PAM source did not make a consistent difference in erosion in this experiment (Table 3 & 4).

Conclusions

PAM was better than straw mulch at reducing sediment loss in this experiment; however, straw was better than PAM at increasing infiltration.

Literature Cited

Shock, C.C., J. Zattiero, K. Kantola, and L.D. Saunders. 1994. Comparative cost and effectiveness of polyacrylamide and straw nulch on sediment loss from furrow irrigated potatoes. Malheur Experiment Station, Oregon State University, Ontario, OR

Trout, T.J., R.E. Sojka, and R.D. Lentz. 1993. Polyacrylamide effect on furrow erosion and infiltration. USDA Research Service. ASAE International Summer Meeting, Spokane, Washington.

Table 1. Erosion control plan for Vernon Nakada's 7 acre, Owyhee silt loam, Onion field, with a slope of 2.1 percent on Morgan Avenue, Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1995.

Tractor Pass	Treatment	Replicate
1*	Border	
2	1. Check	1
3	3. PAM	1
4	2. Straw	1
5	4. PAM + Straw	1
6	2. Straw	2
7	3. PAM	2
8	1. Check	2
9	4. PAM + Straw	2
10	2. Straw	3
11	4. PAM + Straw	3
12	1. Check	3
13	3. PAM	3
14	1. Check	4
15	3. PAM	4
16	2. Straw	4
17	4. PAM + Straw	4
18	2. Straw	5
19	4. PAM + Straw	5
20	1. Check	5
21	3. PAM	5
22	Border	
etc	Border	

Management

* Odd tractor passes receive 1 lb/ac PAM every irrigation
* Even tractor passes receive PAM starting with tractor pass #22
* Tractor passes 4, 5, 6, 9, 10, 11, 16, 17, 18, 19 will receive approximately 150 lb/ac straw mulch.

Morgan Avenue

Table 2. Average sediment loss, water inflow, outflow, and infiltration for furrow irrigated onions, during one irrigation. Erosion control options were furrow mulching with wheat straw at approximately 150 lb/ac, PAM at 1 lb/ac, both or neither. Owyhee silt loam with a 2.1 percent slope on the farm of Vernon Nakada, June 28 through 30, 1995, Ontario, Oregon. Malheur Experiment Station, Oregon State University.

	Sediment loss	Inflow	Outflow	Infiltration
	t/ac	ac-in/ac	ac-in/ac	ac-in/ac
Averages				
Check	0.93	6.3	3.7	2.6
Straw	0.62	7.1	3.9	3.2
PAM	0.36	6.6	3.8	2.8
PAM + straw	0.08	7.3	3.2	4.1
Overall averages				
With straw	0.35	7.2	3.5	3.7
Without straw	0.65	6.4	3.7	2.7
With PAM	0.22	7. 0	3.5	3.5
Without PAM	0.77	6.7	3.8	2.9
LSD (0.05) Straw	ns[&]	ns	ns	0.5
LSD (0.05) PAM	0.41	ns	ns	0.5
LSD (0.05) PAM x straw	ns	ns	ns	ns[#]

& significant at P = 0.17

significant at P = 0.15

Table 3. Sediment loss during a single irrigation of an Owyhee silt loam onion field with a 2.1 percent slope compared to distance from the source of PAM to the furrows treated with a 1 lb/ac of PAM. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1995.

Plot	Distance from PAM source	Sediment loss (lb/ac)
6	44 ft	0.89
12	68 ft 9 in	94.2
2	86 ft	2,784.29
14	89 ft 4 in	731.16
20	149 ft 7 in	7.95

Table 4. Sediment loss in a single irrigation of an Owyhee silt loam onion field with a 2.1 percent slope compared to distance from the source of PAM in furrows treated with both 1 lb/ac PAM and approximately 150 lb/ac straw mulch. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1995.

Plot	Distance from PAM source	Sediment loss (lb/ac)
8	29 ft	15.98
10	45 ft 10 in	148.3
4	64 ft 10 in	38.13
16	109 ft 9 in	612.5
18	129 ft	2.38

Figure 1. Vernon Nakada's onion field on Morgan Avenue. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1995.

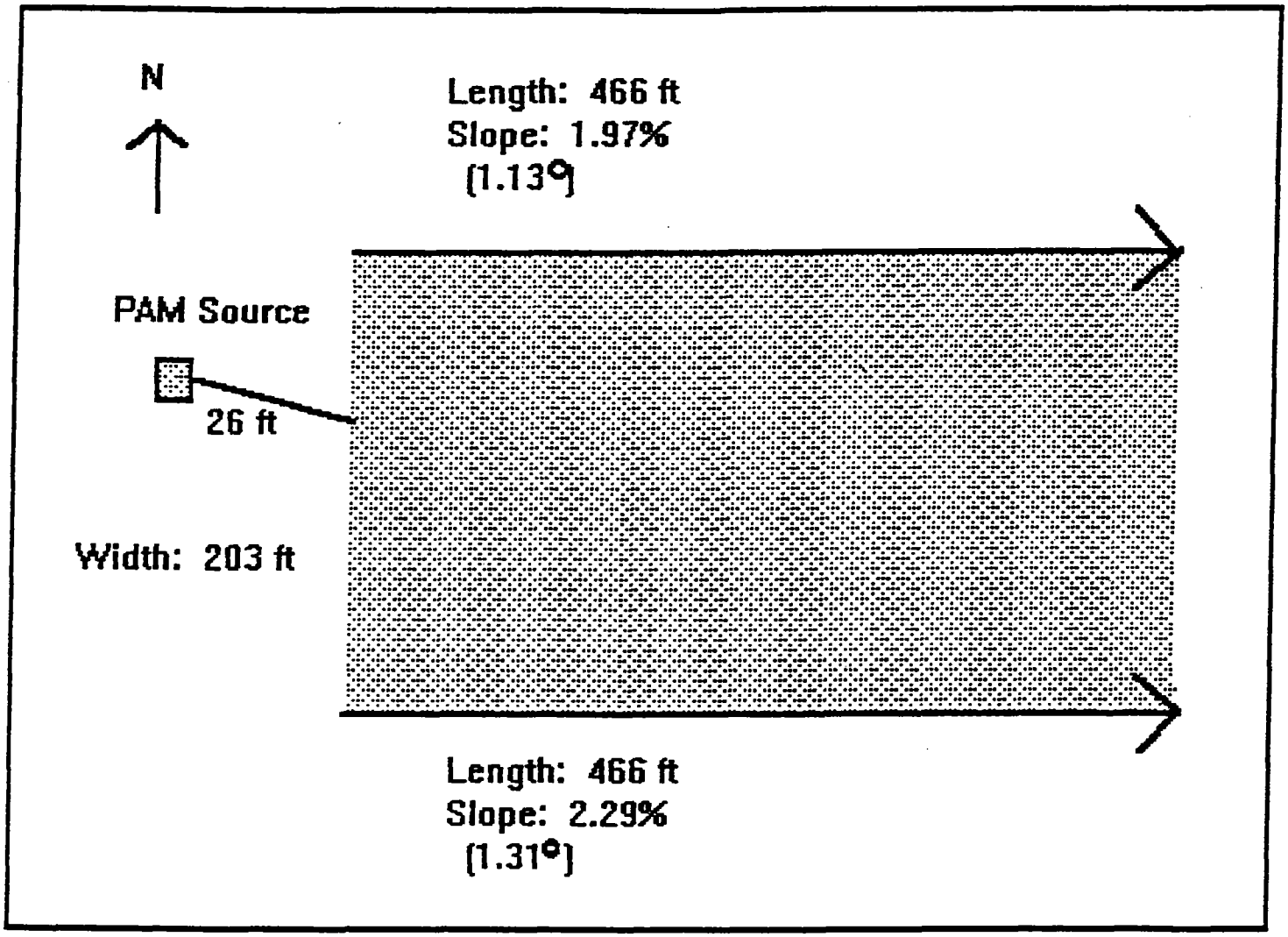

Figure 2. Average sediment loss in furrow irrigated onions during a single irrigation on Owyhee silt loam with 2.1 percent slope. Straw mulch was applied at an approximate rate of 150 lb/ac, PAM was applied at a rate of 1 lb/ac (LSD (0.05) PAM = 820 lb/ac). Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1995.

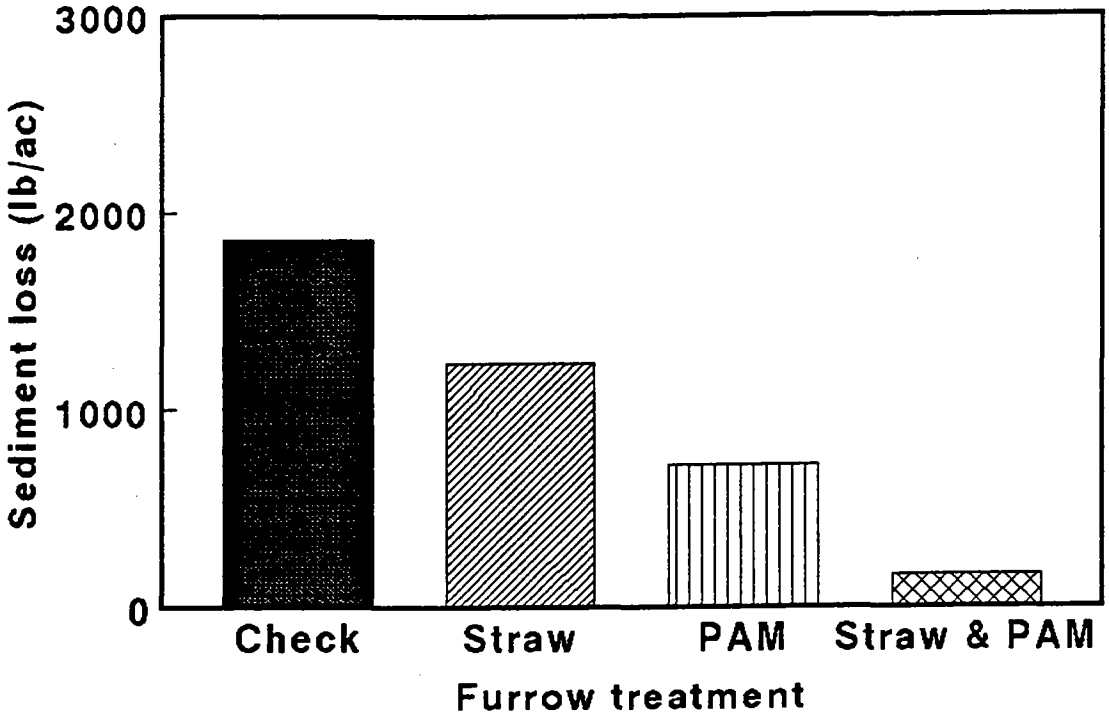

Figure 3. Average infiltration in furrow irrigated onions during a single irrigation on Owyhee silt loam with a 2.1 percent slope. Straw mulch was applied at an approximate rate of 150 lb/ac, PAM was applied at a rate of 1 lb/ac (LSD (0.05) PAM = 0.5 ac-in/ac, LSD (0.05) straw = 0.5 ac-in/ac). Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1995.

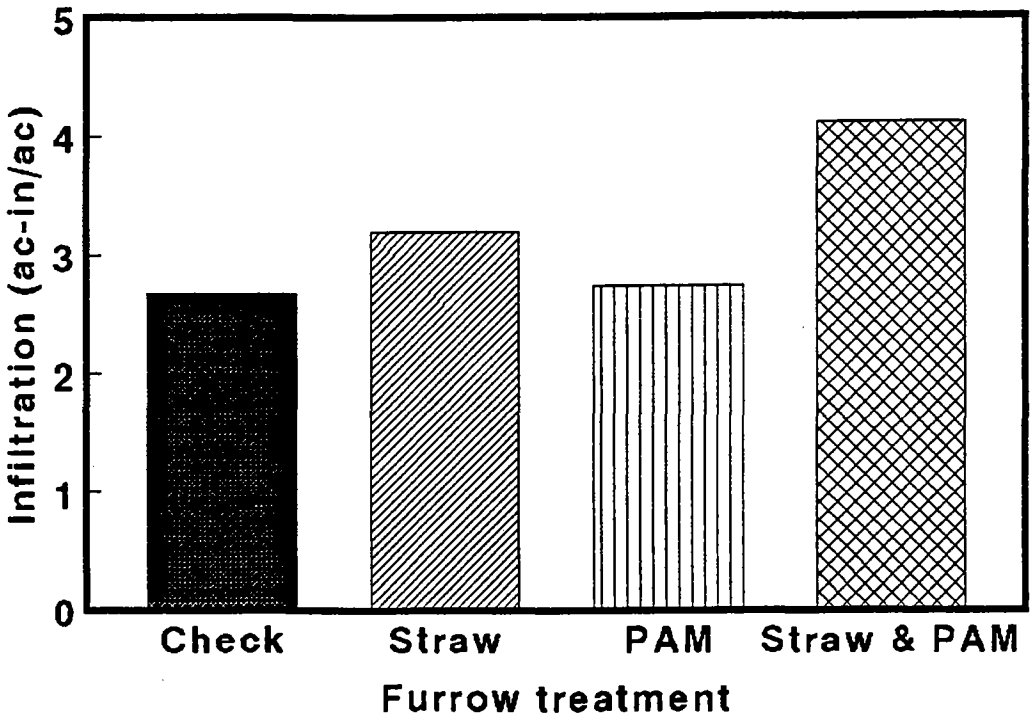

Figure 4. Effect of straw, PAM, or both on infiltration and runoff during a single furrow irrigation on Owyhee silt loam with a 2.1 percent slope. Straw mulch was applied at a rate of approximately 150 lb/ac, PAM was applied at a rate of 1 lb/ac. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1995.

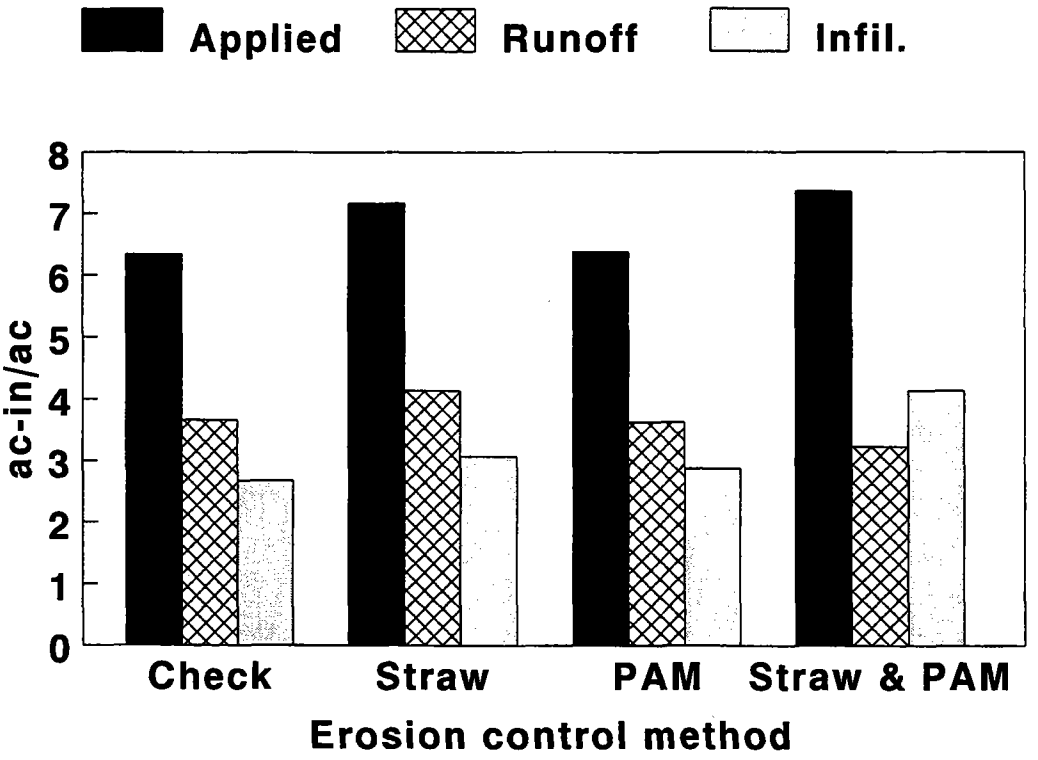

Figure 5. Effect of straw, PAM, or both on infiltration and runoff during a single irrigation on Owyhee silt loam with a 2.1 percent slope. Straw mulch was applied at a rate of approximately 150 lb/ac, PAM was applied at a rate of 1 lb/ac. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1995.