SUSTAINABLE AGRICULTURE TECHNIQUES

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Make Polyacrylamide Work for You!

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Figure 1. Reduction of erosion with PAM (left) compared to no PAM (right).

Figure 2. Clean irrigation water after PAM was applied.

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The erosion solution

Each year, topsoil is gradually washed away by irrigation runoff. Over time, massive quantities of soil can be stripped from fields and carried away in runoff water. Tests by the Oregon State University Malheur Experiment Station and others on the effects of applying polyacrylamide, commonly known as PAM, have concluded that PAM can greatly reduce soil loss (Figure 1). In one study, untreated furrows lost 322 lb soil/acre in runoff water during a single irrigation, while furrows treated with 1 lb PAM/acre lost only 7 lb soil/acre.

What is PAM?

PAM is a synthetic water-soluble polymer composed of molecules of acrylamide. PAM binds soil particles together, causing them to settle out and not be carried away in runoff water. This prevents soil loss and can improve water infiltration.

Does PAM contaminate the environment?

PAM is not harmful to the environment, and is proven to degrade safely into harmless organic molecules over the course of several weeks after application.

Why should growers be interested in PAM?

PAM is highly effective in reducing soil erosion from fields and can increase water infiltration in irrigated furrows. PAM has been shown to reduce soil erosion by 90 to 95 percent when applied to irrigation water (Figure 2).

Sediments leaving agricultural fields in irrigation water typically are high in phosphorus. This nutrient moves into streams, rivers, or reservoirs and contributes to algae blooms and other environmental problems. PAM is an excellent way to conserve soil and nutrients and reduce water pollution.

Farm lands that lie at the lower end of an irrigation canal system can benefit from other farms' soil and phosphorus losses. By adding

PAM to their irrigation water, they can trap and gradually accumulate soil and phosphorus.

PAM's many forms and application techniques make integration into an irrigation routine relatively easy once the initial setup is complete. The increased use and distribution of polyacrylamide products in the past two decades have brought down product prices, making PAM a more economical best management practice (BMP). Polyacrylamide's low cost and high potential for reducing erosion, combined with ease of use, make it a BMP worth considering.

As agriculturalists, it is prudent that we take precautions to prevent soil erosion.

As the Oregon Department of Environmental Quality continues to raise water quality standards, grower familiarity with PAM and its application is good preparation for the future.

How to apply PAM to furrows

The most common and readily available form of PAM is the dry granular form, which can be applied using the "patch method." This method involves using an applicator to sprinkle PAM at the head of the furrow where the water leaves the irrigation ditch (Figure 3). Apply PAM 3 to 5 feet beyond the point at which water enters the furrow to reduce the risk of the PAM becoming buried or washing down the furrow without dissolving.

Place PAM in dry furrows before starting the irrigation. The PAM forms a sort of gel slab at the bottom of the furrow, where the water slowly dissolves it and carries it down the furrow.

Applicators for granular PAM are available from numerous suppliers. Local PAM suppliers can usually recommend applicators suitable for their products. One manual applicator for granular PAM costs $30.

While there are several slightly different versions of manual PAM dispensers, the most common is "The Applicator." The Applicator consists of a PVC pipe with a baffle mechanism at the bottom to measure the PAM. When The Applicator is held at a 45-degree angle, the baffle allows several grams of PAM to flow into a holding chamber. When The Applicator is rotated clockwise 180 degrees, the premeasured PAM is dispensed (Figure 4).

The Applicator comes with two measuring baffles, one designed to apply 2 teaspoons of PAM and another that applies 1 teaspoon of PAM. The two baffle inserts are distinguishable: the 2-teaspoon insert has a flat bottom, while the 1-tablespoon insert has an indented bottom.

A less common PAM dispenser utilizes an RCBS Uniflow Powder Measure model number 09010 (Figure 5). While it resembles The Applicator, it has a different dispensing mechanism; a gunpowder measure gauges the amount of PAM applied. In our tests, the RCBS dispensed smaller amounts of PAM than The Applicator.

Figure 3. Patch method, PAM being applied to the bottom of a furrow before irrigation.

Figure 4. A manual PAM dispenser: The Applicator.

Figure 5. RCBS Uniflow Powder Measure.

Neither The Applicator nor the RCBS Uniflow dispenser consistently deposited the same amount of PAM on each application. The average maximum amount of PAM applied by the RCBS Uniflow Powder Dispenser was 3.76 grams, with a range of 3.37 to 4.36 grams. With the 1-tablespoon insert, The Applicator dispensed an average of 11.6 grams, with a range of 9.75 to 28.04 grams. The 2-teaspoon insert averaged 7.9 grams, with a range of 6.83 to 13.43 grams.

Depending on furrow spacing and length of the field, these amounts of PAM may be considerably less than the 1 lb/acre generally considered necessary (see Table 1, page 4) and may provide insufficient erosion control.

How to apply PAM to an irrigation ditch

Another method of applying PAM is to place a metered dispenser over an irrigation ditch to treat the water (Figures 6 and 7). These dispensers can be programmed to release a specific quantity of PAM into the water over a certain period of time. Some dispensers (not pictured) are belt feeders.

Fields irrigated by gated pipe are good candidates for metered PAM dispensers. Positioning the dispenser upstream allows the PAM to become uniformly mixed into the ditch water before it flows into the field.

The metered PAM dispenser is not recommended for fields with siphon tube irrigation because the PAM-treated water gradually builds up on the inner part of the siphon tubes, causing the tubes to become clogged.

In order for PAM to perform optimally, it needs considerable agitation from the water to dissolve it. If left undisturbed, the granules will clump together and float down the ditch in globules, rendering the PAM less effective in preventing soil erosion or aiding infiltration.

Since PAM can change other characteristics of irrigation such as the water infiltration rate and water advance across the field, monitor irrigations with PAM and make adjustments as needed to optimize irrigation.

Figure 6. Metered PAM dispenser.

Figure 7. Applying PAM with a metered dispenser.

Other forms of PAM

PAM is also available in solid blocks. A block usually is placed in a wire basket and secured to the ditch in a turbulent area. The slowly dissolving block releases PAM into the water.

Emulsified (liquid) PAM can be metered directly from the container into the water in an irrigation ditch, furrow, or pipeline by injector pump. However, this PAM product usually is more readily available where center pivot irrigation systems are prevalent.

Of the three forms, PAM blocks are the least useful in furrow irrigation, as there is no way to make the blocks disperse the PAM uniformly.

When is it most important to apply PAM?

Soil is more erodible when it is newly worked. Soil losses from irrigation-induced erosion are greatest when soil is loose. PAM has the greatest benefit in reducing erosion following cultivation and other tillage operations.

Secondary applications of PAM may be needed for subsequent irrigations on undisturbed soil when erosion is noted or anticipated. Growers can adjust PAM rates downward on undisturbed soil for sequential irrigations where PAM has been used previously, keeping in mind erosion control.

Safety and health

PAM solutions can cause flooring and tool surfaces to become very slippery when wet. These slippery conditions can pose a safety hazard. Sweep up dry PAM spills and clean up liquid PAM spills with dry absorbent materials such as sawdust, soil, cat litter, etc.

Use protective clothing in accordance with the product label and other standards. Inhaled PAM dust can cause difficulty breathing and can be a choking hazard. Dust masks are required according to labels and standards.

Runoff water containing PAM can cause flocculation and sedimentation if it merges downstream with water carrying a sediment load. This sedimentation must be managed to prevent interference with irrigation and drainage.

For more information

Burton D., J. Trenkel, and C.C. Shock. 1996. Effects of polyacrylamide application method on soil erosion and water infiltration. OSU Malheur Experiment Station Special Report 964:186–191.

Lentz, R.D., I. Shainberg, R.E. Sojka, and D.L Carter. 1992. Preventing irrigation furrow erosion with small application of polymers. Soil Sci. Soc. Am. J. 56:1926–1932.

Table 1. Recommended application rates when using the patch method at the head of the furrow to provide 1 lb PAM/acre with different furrow spacings and lengths. Malheur Experiment Station.

	Furrow length		
Furrow spacing (inches)	1,320 ft (¼ mile)	880 ft (⅙ mile)	440 ft (1⁄12 mile)
	g/furrow (oz/furrow)		
22	25.2 (0.890)	16.8 (0.598)	8.4 (0.297)
30	34.5 (1.217)	23.0 (0.811)	11.5 (0.406)
36	41.5 (1.464)	27.6 (0.976)	13.8 (0.488)
38	43.6 (1.538)	29.2 (1.025)	14.6 (0.513)
40	46.1 (1.626)	30.7 (1.084)	15.4 (0.542)
44	50.7 (1.788)	33.8 (1.192)	16.9 (0.596)

Shock, C.C. and B.M. Shock. 1997. Comparative effectiveness of polyacrylamide and straw mulch to control erosion and enhance water infiltration. In Wallace, A., ed. Handbook of Soil Conditioners. Marcel Dekker, Inc., New York, NY. pp. 429–444.

Shock, C.C. 2007. Malheur County Best Management Practices. http://www.cropinfo.net/bestpractices/mainpagebmp.html

USDA–NRCS. 2001. Anionic polyacrylamide (PAM) erosion control. Natural Resources Conservation Service Conservation Practice Standard 450-1.

For more Extension publications on irrigation management, visit the OSU Extension website at http://extension.oregonstate.edu/catalog/

Product sources

SoilSavers DryPAM Micro-Dispenser
SoilSavers Co.
P.O. Box 1854, Riverton, WY

The Applicator, Soil Bond granular PAM, Retain emulsion, and PAM tablets
Integrated Biological Systems, Inc.
P.O. Box 554, Nampa, ID 83653-0554

Soil Binder DC
Simplot Co., Boise, ID
sold by Simplot Grower Solutions

PAM Belt Feeder, Ark Fisheries, 2825 S. 1050 E., Hagerman, ID 83332

Trade-name products are mentioned as illustrations only. This does not mean that the Oregon State University Extension Service either endorses these products or intends to discriminate against products not mentioned.

Quick facts

- Polyacrylamide (PAM) can significantly reduce soil erosion and phosphorus loss caused by runoff from furrow irrigation.
- PAM's effectiveness lies in its ability to bind soil particles together, which helps prevent them from being washed away by runoff water.
- PAM has been shown to reduce soil erosion by 90 to 95 percent when applied to irrigation water.
- PAM's relatively low cost and its three forms make integration into an irrigation routine relatively easy.
- When irrigating with siphon tubes, the easiest and most effective method of applying PAM is through the patch method, using the granular form at the head of each furrow.
- The amount of PAM to apply using the patch method depends on the length and spacing of the furrows.
- When irrigating by gated pipe, metered PAM dispensers are an easy and effective method of applying PAM.
- Manage PAM applications in accordance with product labels. Protect human health and keep in mind possible downstream effects.

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