A clear advantage

Used with sprinklers, PAM helps improve runoff quality

By Vicky Boyd, Editor

Farmers using sprinkler irrigation in California's salad bowl are taking a lesson from the water treatment industry to help clean the runoff leaving their fields.

Spurred by University of California research, a small but growing number of lettuce producers in the Salinas Valley are using PAM, or polyacrylamide, to reduce the sediment and accompanying nutrients leaving their fields.

"The tail water comes off almost crystal clear as opposed to discharge running off laden with sediment like chocolate," says Bob Martin, a King City, Calif., farm manager who's been following the PAM research. "If you leave the sediment in the field or in the ditch, you are basically solving many of the problems of water quality."

Polymers in PAM work by binding to suspended sediments, causing them to drop out of the water. That's the same process water treatment plants use to improve water clarity.

Although PAM doesn't reduce the amount of runoff leaving the field, it cleans it up significantly, says Mike Cahn, a University of California Cooperative Extension farm advisor for water resources and irrigation.

Depending on the soil type, irrigation water chemistry, slope and irrigation systems, growers can see sediment losses reduced by as much as 95 percent with PAM, Cahn says. On the average, they can expect about an 80-precent reduction in sediments.

Because many nutrients bind themselves to sediment particles, Cahn's experiments also demonstrated a significant reduction in nutrients leaving the field. On one site, the amount of total phosphorus was reduced by 70 percent.

"Consistently, we can drop that discharge by about half, which is pretty encouraging," says Cahn, who works with growers in Monterey, San Benito and Santa Cruz counties. "There are a lot of nutrients that adhere to the sediments. If you can keep the sediments in place, you keep the nutrients in place."

Cahn is quick to point out that PAM isn't the silver bullet some growers are searching for to solve all of their irrigation water quality woes. Instead, he says it's another tool that they can use on top of other best management practices to help manage irrigation runoff quality.

"We don't have any management practices that are this effective for cleaning tail water," Cahn says. "We couldn't do this with grassed waterways or buffer strips, and this doesn't impede crop production. Buffer strips take up land and you create habitat for pests, such as rodents."

And improving runoff quality has come to the forefront as the Central Coast Regional Water Quality Control Board is pressuring Salinas Valley growers to reduce pollution flowing into nearby Monterey Bay and the Monterey Bay National Marine Sanctuary.

A sprinkling of research trials

Although growers have used PAM for several years to help reduce sediments leaving furrow-irrigated fields, few growers presumably use it with sprinklers.

In fact, Dave Bjorneberg, an agricultural engineer with the U.S. Department of Agriculture's Northwest Irrigation and Soils Research Laboratory in Kimberly, Idaho, says he's been unable to get a handle on just how many growers are using it with sprinklers.

"I say it's a no-brainer to use in furrows," Bjorneberg says. "You have erosion with most soils that have slopes to them, and PAM just makes sense.

"With sprinklers, it's a hassle to apply to the crop. And you are looking at $10 to $30 per acre, which if you are growing corn, that takes away most of your profit margin."

What work has been conducted with PAM and sprinklers focused mostly on rates of 10 parts per million.

Cahn and Husein Ajwa, a UC vegetable Extension specialist collaborating on the project, weren't deterred by the scant results they found in a literature search. Initially they looked at PAM applied through sprinklers as a way to reduce runoff by improving infiltration.

At the rates used with furrow irrigation—about 20 ppm—they found PAM applied through sprinklers actually reduced infiltration in their tests.

So they began seeing how low a concentration they could use and reduce sedimentation without affecting infiltration. They first conducted laboratory tests to see if

Photo courtesy of the NRCS

The critical time for lettuce is early in the season, when growers use sprinkler irrigation to germinate seed. Once the plants are a few inches tall, an increasing number switch to drip irrigation—which has a lower potential for runoff than sprinklers.

using concentrations as low as 5 ppm would work, and they found they would.

They also knew that ease of use would be a determining factor in how many growers would eventually adopt the practice.

Granular PAM has to be added to water slowly and mixed well to avoid creating a gelatinous mess. So the two looked at SoilFloc 300E, an emulsified liquid from Hydrosorb that could be injected into the sprinkler system and that was also economical.

And not all areas in the Salinas Valley are candidates for the treatment, either, Cahn says. In some areas, growers either don't discharge irrigation runoff or they contain it in tail-water collection ponds for reuse.

In trials, the researchers found some fields only lost 36 pounds of soil per acre per irrigation while others lost as much as 200 pounds per acre.

Putting PAM to the test

In 2004, Cahn and Ajwa took their research to the field to conduct grower trials and demonstrations. Although most of the trials involved lettuce, one involved raspberries that were being established at planting.

The critical time for lettuce is early in the season, when growers use sprinkler irrigation to germinate seed. Typically, that involves three or four irrigations.

Once the plants are a few inches tall, an increasing number of growers switch to drip irrigation—which has a lower potential for runoff than sprinklers—for the remainder of the season.

Based on the demonstrations, Cahn says growers should inject PAM at a rate of 5 ppm into the water for the first 30 minutes of an irrigation set. They turn it off until they see a bit of ponding in the furrows, then restart the injection and run it until the end of the irrigation set.

"If there's no runoff, then you don't run it," Cahn says. "If the runoff starts, then you start it. In some soil types, it doesn't run off until six hours. And there are some soil types where you don't get any runoff because they are so well drained."

At 5 ppm, that means growers are applying about 0.5 pounds of active ingredient per acre for a typical four-hour irrigation, and the product costs about $3 to $4 per pound.

Probably more costly, Cahn says, is the labor involved in injecting and monitoring the treatments.

Which PAM is right?

Although several formulations of polyacrylamide, or PAM, are available, few are suitable for agricultural use, says Mike Cahn, a University of California Cooperative Extension farm advisor for water resources and irrigation.

PAM is a polymer, which is a long chain molecule made up of repeating subunits. In fact, the ag-approved products contain more than 100,000 repeating units per molecule. The polymers attach to soil particles, causing the sediment to clump together, and become too heavy to stay suspended in water and drop to the bottom.

Photo by Mike Cahn, UC Cooperative Extension

In sloping fields with soils prone to irrigation-induced erosion, PAM applied through sprinklers can reduce the sediments in runoff by an average of 80 percent (left) compared to untreated fields.

For use on farms, the PAM product needs to be anionic, or negatively charged, and have a very low short chain, or monomer, content. It also needs to be food grade and approved by the Environmental Protection Agency for use in agriculture.

The simplest way to find out if the PAM product you're considering is right is by calling the local Natural Resources Conservation Service, Cahn says. In some areas, such as the Salinas Valley, Calif., using PAM qualifies for cost-share funding through the NRCS Environmental Quality Incentive Program.

INTERNET HOTLINK

U.S. Department of Agriculture
PAM Page:
http://kimberly.ars.usda.gov/pampage.shtml