

RESEARCH PROJECT TITLE: The influence of polyacrylamide on the movement of soil-applied herbicides in furrow-irrigated dry bean (*Phaseolus vulgaris*)

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INTERIM OR FINAL REPORT: Final

PROJECT OBJECTIVES:

1. Determine the effect of polyacrylamide (PAM) on the transport of two herbicide classes represented by ethalfluralin and dimethenamid-P from the field in the irrigation outflow and eroded soil sediments, using furrow-irrigated dry bean as a model crop.
2. Determine the effect of PAM on the vertical and lateral movement of these herbicides in the soil.
3. Evaluate crop injury by visual assessment and measuring fresh weight of aboveground biomass of the crop.
4. Evaluate weed control efficacy by determining weed populations prior to the initial irrigation and 7 to 10 days after each subsequent irrigation.
5. Determine the effect of PAM on weed seed migration from the field in irrigation water.

KEY WORDS: polyacrylamide, ethalfluralin, dimethenamid-P

STATEMENT OF PROBLEM: Irrigated agriculture has been identified as a major non-point source of water pollution. Over 7,904,000 acres are irrigated in the PNW with about 43% surface irrigated. Return flows from eroded fields to surface water may include soil sediment, nutrients, and pesticides. From 12 to 124 tons of soil per acre can be lost each year from typical surface irrigated fields in the PNW.

Using polyacrylamide (PAM) in surface irrigation can reduce soil erosion from furrow-irrigated fields by 94% and increase infiltration by 15%. However, little is known how PAM may influence the movement of soil-applied herbicides. If this technology is to develop to its full potential, it is necessary to understand the influence that it may have on the movement of soil-applied herbicides both within the field and from the field.

ZONE OF INTEREST: Irrigated agriculture in the PNW

ABSTRACT OF RESEARCH FINDINGS: This project was initiated in May 2000 and data collection completed in 2001. STEEP funding provided the salary of a graduate student and the cost of herbicide residue analysis of soil and water samples. Unfortunately, the graduate student hired for this project accepted employment elsewhere before completing the requirements for an M.S. degree. However, the graduate student is writing the results of this study for his thesis. All of the soil and water samples have been analyzed for herbicide residues and the data have been statistically analyzed. Weed seeds that were collected continuously from the irrigation run-off to determine total weed seed migration were influenced by PAM. Polyacrylamide-treated irrigation water reduced broadleaf weed seed migration 34% to 98%, depending on the species, compared to untreated irrigation water. Weed seed migration from ethalfluralin, dimethenamid-P, and control herbicide treatments ranged from 34 to 99%, depending on weed species. In the ethalfluralin, dimethenamid-P, and control herbicide treatments, grass weed seed migration in

irrigation run-off was reduced 26% to 99%, when PAM was present. More significantly polyacrylamide-treated irrigation water reduced ethalfluralin herbicide concentrations in run-off water compared to water without PAM. Dimethenamid-P herbicide concentrations in irrigation water do not appear to be reduced with the addition of PAM.

**RESULTS AND INTERPRETATION:** Seed collected in runoff from the following broadleaf weed species were: common lambsquarters, redroot pigweed, kochia, hairy nightshade, and common mallow. Grass weed seed were collected in runoff from the following species: barnyardgrass, wild-proso millet, green foxtail, and yellow foxtail. Polyacrylamide-treated irrigation water reduced broadleaf weed seed migration 34% to 98%, depending on the species, compared to untreated irrigation water. However, no differences in weed seed numbers were observed among the broadleaf or grass weed species due to variability in seed numbers. Thus, weed seed were grouped by broadleaf and grass species. Using PAM reduced broadleaf weed seeds in runoff by 84 and 60% in 2000 and 2001, respectively. PAM-treated irrigation water also reduced grass weed seed in runoff by 83 and 68% in 2000 and 2001, respectively. There was no difference in broadleaf weed seed in runoff between the control, dimethenamid-P, or ethalfluralin weed control treatments when PAM was not used. Without PAM, the three weed control treatments averaged 40,000 broadleaf seeds/ha. However, grass weed seed runoff was less in the control compared to dimethenamid-P and ethalfluralin. This is thought to be due to the presence of weeds in the furrow of the control treatments, which impeded water flow enough to also trap more weed seed in the furrow than the two herbicide treatments. With PAM, less broadleaf and grass weed was in the runoff of the dimethenamid-P treatment compared to the control and ethalfluralin. However, the amount of weed seed in the PAM-treated water averaged about 7,000 seeds/ha.

Ethalfluralin and dimethenamid-P were chosen for this study because of the differences in their behavior in soil with regard to leaching and mobility. Both herbicides were detected in the first three irrigations, although the first irrigation had the highest concentrations, regardless of PAM treatment. No herbicide was detected in the fourth and fifth irrigation. In 2000, PAM reduced ethalfluralin in runoff water 85% compared to not using PAM. Dimethenamid-P runoff was reduced by about 39% in PAM-treated water. The amount of ethalfluralin in runoff water without PAM was about 56% greater than dimethenamid-P. This could be attributed to differences in application rate. Ethalfluralin and dimethenamid-P were applied at 1.7 and 0.7 kg ai/ha. In addition, ethalfluralin in runoff was higher in runoff water without PAM because it was likely adsorbed to soil sediment that was carried away in the runoff water. In 2001, PAM did not affect herbicide movement in runoff water. This was attributed to light to moderate precipitation received the night before the first irrigation. In other PAM studies, light to moderate precipitation prior to an irrigation event reduce the effectiveness of PAM on reducing soil erosion. We observed the same response in our study. Typically, PAM will reduce soil erosion in furrow irrigated fields 90 to 95% or higher. Following precipitation, PAM-treated furrows will only reduce erosion 50 to 60%. Exactly what causes this is unknown.

Another benefit to using PAM in furrow irrigation is higher infiltration rates into the soil profile. A concern from this is if a soil-applied herbicide may leach more in soil irrigated with PAM-treated water. Analysis of soil samples taken through the growing season in the top, middle, and bottom of the study site showed no difference in herbicide movement between PAM treatments. No difference in leaching behavior between ethalfluralin and dimethenamid-P were observed.

No differences observed in herbicide movement between PAM treatments.

Based on the results of this study, further evidence was developed to demonstrate the ability of PAM for reducing soil erosion in furrow irrigation. This study also showed that weed control and crop safety are not affected by ethalfluralin or dimethenamid-P. Both of these herbicides behaved the same with or without PAM. Polyacrylamide also did not affect horizontal or vertical movement of either herbicide used in a furrow irrigation system.

**INTERACTION (COOPERATION) WITH OTHER SCIENTISTS CONDUCTING RELATED ACTIVITY:** We have worked with Dr. Pamela Hutchinson, University of Idaho and Dr. Robert Sojka, USDA-ARS in Kimberly, Idaho.

**PUBLICATIONS AND PRESENTATIONS:**

Sojka, R.E., J.A. Entry, W.J. Orts, D.W. Morishita, C.W. Ross, and D.J. Horne. 2003. Synthetic- and Bio-polymer use for runoff water quality management in irrigated agriculture. p. 3-130 - 3-136. *In*: M. Bruen (ed.) Proc. 7th Intl. Specialised Conf. Diffuse Pollution Basin Management and 36th Scientific Mtg. Estuarine and Coastal Sci. Assoc. Dublin, Ireland.

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