Polyacrylamide Soil Amendment Improves Water Quality in Nurseries

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What is polyacrylamide (PAM)?

- L**ong-chained polymer** used to aggregate (flocculate) and help settle suspended solids.
  - Forms used are anionic and non-toxic.
  - *Not* the cross-linked gels used for water absorption.
- **Non-agricultural uses:**
  - Waste and potable water treatment.
  - Processing and washing fruits and vegetables.
  - Clarification of juices, wine, and beer.
  - Manufacturing of cosmetics and paper products.
- **Agricultural and other commercial land uses:**
  - Stabilizing soil, preventing soil erosion
  - Reducing sediment in runoff water.

Polymers check furrow erosion, help river life

Each year, irrigation runoff from West Stanislaus County farmland carries about 1.2 million tons of sediment into the San Joaquin River. The sediment contains pesticides that pollute and threaten aquatic wildlife. One solution for this problem is to add dissolved polyacrylamide polymers into irrigation water, a practice which reduces soil erosion and has economic benefits to the grower, such as increasing infiltration rates. In recent trials, this practice reduced soil erosion and runoff water from a furrow-irrigated spinach field. Polyacrylamide-treated furrows had a 10% lower outflow rate than the untreated furrows. In addition, the polyacrylamide flocculated the suspended soil particles; on average, 99.7% settled out compared to soil particles in untreated furrows.

California Agriculture, Sept./Oct. 1993

PAM liquid injected in water for sprinkler or furrow irrigation, or applied in furrows as tablets or granules

Delivery and maintenance on large scale is the problem for growers

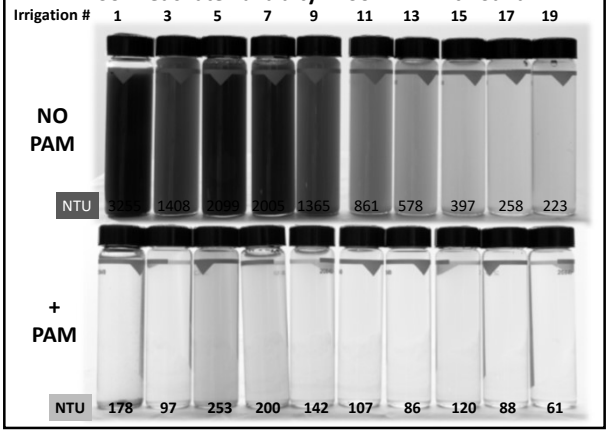
Potting soil amended with PAM ?

PAM added to potting mix and distributed into nursery with new plants

Improving Water Quality in California Nursery Crops using Polyacrylamide (PAM)

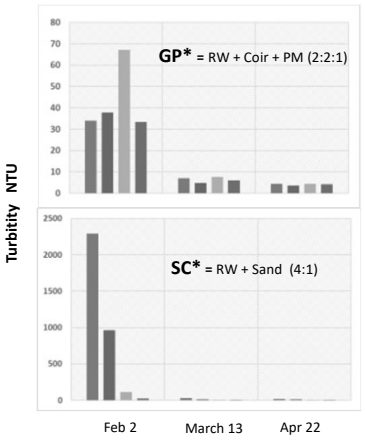
- S. Tjosvold, M. Cahn, and R. Lentz
- **Goal:** to reduce sediment and associated nutrients in nursery runoff with PAM- amended potting soil.
- **Funding:**
  California Specialty Crop Block Grant (Oct 2013 to June 2016)
  California Association of Nurseries and Garden Centers (2013)
- **Field Sites:**
  - **Sunland Garden Products / Berger**, *Watsonville, CA.*
  - **Suncrest Nursery**, *Watsonville CA.*
  - **Monterey Bay Nursery**, *Royal Oaks CA.*
- **David Chambers**, *Staff Research Associate, UC Cooperative Extension*

Soil Leachate Turbidity in Soil Mix with Sand



Soil Leachate Turbidity in Soil Mix with Sand

Soil Leachate Turbidity in Two Commercial Soil Mixes*



* Four PAM rates, Greenhouse, Osteospermum (6" pot), Feb 1 first irrigation, April 22 irrigation at harvest

Does PAM have any adverse growth effect?

Tested in greenhouse or field:

- *Lavandula*
- *Epilobium*
- *Heterotheca*
- *Gaura*
- *Osteospermum*

Vol water applied = Δ weight + Δ weight*0.18 (leaching fraction)

Effect of PAM Concentration

Fresh and Dry Weights per Plant at Harvest (grams)

	Untreated		50 g/m3		100 g/m³		200 g/m³		400 g/m³		SIG / NS	
Media	**FW**	**DW**	**FW**	**DW**	**FW**	**DW**	**FW**	**DW**	**FW**	**DW**	**FW**	**DW**
GP	60.9	12.4	57.2	11.6	62.9	13.0	62.8	12.5	60.7	12.4	NS	NS
SC	72.9	14.9	52.2	10.5	69.7	14.4	58.1	12.1	59.0	12.7	NS	NS
OM	50.0	13.0	49.3	13.5	54.6	15.3	49.6	14.0	54.4	14.9	NS	NS
AUS	37.1	10.6	35.4	10.1	36.6	10.3	34.1	10.4	36.2	10.8	NS	NS

GP= RW + Coir + PM (2:2:1);
SC = RW + Sand (4:1);
OM= RW + Coir + lava (80:15:5) ;
AUS= RW+ Lava + Sand (60:25:15).

Lavandula x intermedia 'Grosso' grown in GP and SC,
Lavandula stoechas 'Silver Anuk' grown in OM and AUS

NS = not significant p < 0.05

Soil Physical Properties measured after drainage

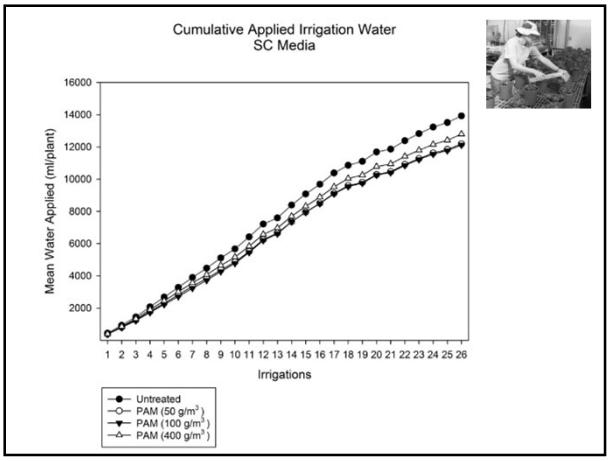
- Bulk Volume
- Total Porosity (%)
  - Water Filled Pores (%)
  - Air Filled Pores (%)

% Total Porosity, Water, Air, and Bulk Volumes

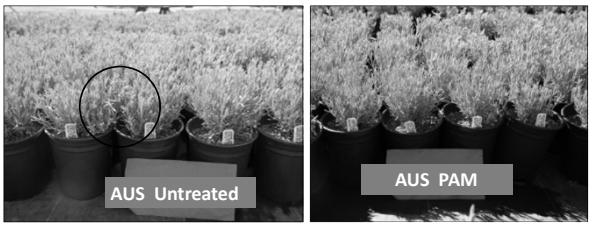
PAM rate:	0	25 g/m³	50 g/m³	100 g/m³	200 g/m³	400 g/m³	SIG
SC = RW + Sand (4:1)							
Bulk Volume	2101	2120	2112	2055	2141	2139	NS
Total Porosity %	76.8	77.0	76.9	76.2	77.2	77.2	NS
Water %	48.2	48.9	56.2	50.2	55.9	49.3	* +
Air %	28.5	28.1	20.7	26.0	21.3	27.8	* -
CMS = RW + Coir + Lava + Loam (70:15:5:10)							
Bulk Volume	2173	2093	2212	2157	2114	2162	NS
Total Porosity %	84.7	84.1	84.9	84.5	84.2	84.6	NS
Water %	50.4	50.6	50.3	49.8	51.4	51.0	NS
Air %	34.3	33.5	34.6	34.7	32.8	33.6	NS
GP = RW + Coir + PM (2:2:1)							
Bulk Volume	2112	2012	1979	1951	2019	1957	* -
Total Porosity %	93.1	92.7	92.6	92.5	92.8	92.5	* -
Water %	75.7	68.3	65.5	62.1	68.2	67.9	* -
Air %	17.3	24.5	27.1	30.4	24.6	24.6	* +

Total, Water and Air = % vol.
AFTER DRAINAGE

SIG * Contrasts 0 vs PAM, Fisher's LSD 95%
NS Not Significant



Effect of PAM on Wilting



Nursery Evaluations

200 1-gal pots placed "pot to pot" in a monitored 100 sq.ft. plot, PAM +/- 100 g/m³

Pot Leachate Loss (mg/pot/irrigation) and Turbidity (NTU)

	Turb.			Susp. Solids			Org. N			NO_3- N			NH_4- N			PO_4			P total		
Media	0	PAM	SE	0	PAM	SE	0	PAM	SE	0	PAM	SE	0	PAM	SE	0	PAM	SE	0	PAM	SE
GP	10.2	12.5	0.9	4.3	3.8	0.8	0.66	1.15	0.17*	2.0	2.1	0.5	3.9	3.0	1.3	3.7	4.4	0.7	4.2	4.8	0.8
SC	45.3	15.0	7.8**	10.2	6.1	1.4*	0.3	0.1	0.07	8.9	6.8	1.5	6.8	6.7	1.5	0.50	0.22	0.17	0.50	0.23	0.16
OM	19.5	10.6	3.2	25.4	22.4	4.0	2.4	6.4	3.6	14.4	17.5	3.5	11.3	13.5	4.5	10.1	10.7	2.2	11.2	11.7	2.5
AUS	38.7	7.4	4.8 **	33.5	17.6	4.9 *	1.3	0.5	0.6	16.5	14.9	3.7	1.3	2.0	0.5	0.15	0.11	0.02	0.25	0.14	0.03*

GP= RW + Coir + PM; **SC** = RW + Sand; **OM**= RW + Coir + lava ; **AUS**= RW+ Lava + Sand

SE = standard error
** Significant p<0.01 * p< 0.05

Plot Runoff: Mean Concentration mg/L. Turbidity (NTU)

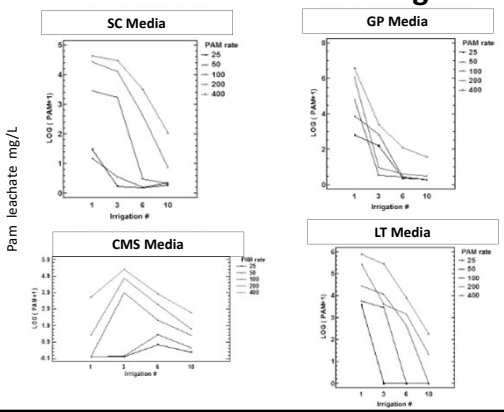
	Turb.			Susp. Solids			Org. N			NO_3- N			NH_4- N			PO_4			P total		
Media	0	PAM	SE	0	PAM	SE	0	PAM	SE	0	PAM	SE	0	PAM	SE	0	PAM	SE	0	PAM	SE
GP	10.5	10.1	1.1	20.4	27.4	3.2	8.2	7.8	1.8	21.3	24.9	1.4	2.9	3.5	0.9	2.5	4.0	0.5*	2.8	4.9	0.7*
SC	9.9	9.4	1.0	18.1	18.0	1.6	8.7	8.9	1.9	21.8	23.3	1.3	2.4	2.5	0.5	1.4	1.3	0.1	1.5	1.4	0.1
OM	4.5	7.8	1.1	11.1	23.4	6.2	28.2	46.0	12.4	16.2	25.6	7.8	12.0	20.4	11.7	21.9	37.5	4.0*	10.4	20.6	5.8
AUS	4.4	3.0	0.6	0.3	0.3	0.02	15.5	15.6	4.3	6.0	6.0	1.5	11.0	9.7	3.2	15.1	15.1	2.2	0.3	0.3	0.02

GP= RW + Coir + PM; **SC** = RW + Sand; **OM**= RW + Coir + lava ; **AUS**= RW+ Lava + Sand

SE = standard error
* Significant p< 0.05

PAM rates and release rate

PAM in Leachate after Irrigation



Four- Month Field Plots: Effect of PAM on Soil Settling at Harvest ?

	Soil Volume mean (ml/pot)		
Media	Untreated	PAM	SE
GP	2091.5	2158.3	23.3 *
SC	2155.2	2195.2	17.2
OM	2184.5	2199.5	26.0
AUS	2115.5	2084.5	25.3

SE = standard error *Significant p = 0.0541

Summary

- PAM **reduces** turbidity (NTU) 67 to 80 % in sand component soils.
- PAM **reduces** suspended solids (SS) in leachate 40 to 47% in sand component soils.
- Organic soils have relatively low tubidity and SS.
- Effective PAM rate about 100 g/m^3
- No reduction of growth at all tested PAM rates (25, 50, 100, and 400 g/m^3).
- PAM leaches out of pot in the first 10 irrigations.
- About half cent per 1 gallon pot.
- Some increase in water holding capacity in some soils.
- Some reduction of soil shrinkage in some soils.

Summary

- Mixing such small rates uniformly may be an issue. PAM rate is about ½ of the amount that would be added preplant for potassium nitrate fertilizer.
- PAM leachate could be slippery on floors or ground at highest normal concentrations.
- Soil media should be kept dry. No soil piles uncovered in the rain. Covering soil is a good idea anyway at anytime.

Thanks