# YIELD AND QUALITY OF FOUR POTATO CULTIVARS IN RESPONSE TO PAM (Polyacrylamide) TREATMENT OF IRRIGATION WATER

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## Summary

Russet Burbank, Shepody, Frontier Russet, and Ranger Russet potatoes were tested for their response to furrow irrigation with PAM-treated irrigation water. Treatment of irrigation water with PAM did not result in any difference in potato yield or grade in 1995. The use of PAM was found to be associated with lighter frying tubers, over all varieties.

## Introduction

Polyacrylamide (PAM) is a water soluble polymer and is a high potency flocculent. PAM has been shown to significantly reduce soil erosion (90-95 % reduction) associated with surface irrigation when applied to irrigation water. The PAM application rate for effective erosion control is approximately 1 lb/acre/irrigation for the first few irrigations (Shock et al., 1995). The need for PAM in subsequent irrigations is not well established.

PAM has been shown to maintain soil water infiltration rates during the season and to reduce the compaction of the soil caused by surface irrigation (Terry and Nelson, 1986; Wallace et al., 1986). Furrow irrigated potato production with PAM treated water could result in an increase in tuber yield and quality and more "mellow" soil at harvest reducing clods and soil attached to tubers.

## Procedures

The 1995 trial was conducted on an Owyhee silt loam previously planted to wheat at the Malheur Experiment Station. The field was bedded into 36-inch hills in the fall of 1994. A soil sample taken from the top foot on May 1, 1995 showed a pH of 7.8, 1.7 percent organic matter, 19 CEC, 8 ppm nitrate-N, 4 ppm ammonium-N, 13 ppm phosphorus, 439 ppm potassium, 2350 ppm calcium, 383 ppm magnesium, 370 ppm sodium, 1.0 ppm zinc, 12.2 ppm iron, 8.8 ppm manganese, 1.0 ppm copper, 19 ppm sulfate-S and 0.7 ppm boron.

Two-ounce seed pieces were planted April 27 at 9-inch spacing. On May 19, Thimet 20G insecticide at 3 lbs ai/ac was shanked-in with urea at 100 lb N/ac. The urea was applied after planting and before emergence to both sides of the hill. The shanks were adjusted to place the urea in bands located at the same depth as the seed piece and

offset 9 inches from the hill center. The hills were remade with a Lilliston cultivator. The herbicides Prowl at 1 lb ai/ac and Dual at 2 lbs ai/ac were broadcast on the entire soil surface on May 23 and incorporated with the Lilliston. Forty four pounds of N/ac were applied as water-run urea on July 14. A late blight and insect control program consisting of weekly aerial applications of fungicide and insecticide mixes was initiated on July 14 and run through August 26.

The plots were furrow irrigated and received either PAM-treated or untreated water at each irrigation. PAM was applied as an aqueous solution at 1 lb/ac during the first two irrigations and at 0.2 lb/ac during subsequent irrigations (Table 1). The premixed PAM solution was applied directly into the irrigation water by way of a K-Box in the transmission line in order to enhance mixing with the irrigation water. PAM application rate was adjusted so that 80 percent of the PAM was applied during the advance time and the remainder of the PAM was applied during the rest of the irrigation set. Four potato varieties (Russet Burbank, Shepody, Frontier Russet, and Ranger Russet) were split-plots within the main plots. The treatments were replicated six times.

Four granular matrix sensors (GMS, Watermark Soil Moisture Sensors Model 200SS, Irrometer Co., Riverside, CA) were installed in the top foot of soil and one GMS was placed in the second foot of soil in each plot. The GMS in the top foot of soil were offset 6 inches from the hill top and centered 8 inches below the hill surface and the second foot GMS were placed in the hill center and centered 20 inches below the hill surface. Half of the first foot sensors were located on the wheel traffic side of the potato hill and the other half were located on the non-wheel traffic side of the hill. Sensors were read five times per week from June 10 to September 4 at 8 AM. Irrigations were scheduled to avoid the average soil water potential in the first foot of soil drying beyond -50 kPa. PAM-treated and untreated plots were irrigated separately as needed.

At each irrigation, every other furrow was irrigated, with the irrigated furrows alternating from irrigation to irrigation. Seventeen irrigations were required by the untreated plots and 18 irrigations were required by the PAM-treated plots from June 12 to September 1. Irrigation durations were 24 hours from June 12 through July 17 and 12 hours from July 17 through September 1.

Petiole samples were collected every two weeks from June 21 to August 16, and analyzed for nitrate. Russet Burbank, Shepody, and Frontier Russet plants in each plot were sampled. Tubers from 40 feet in each plot were harvested on September 26 and evaluated for yield and grade. A subsample was stored and analyzed for tuber specific gravity and stem-end fry color in early November.

Two soil bulk density samples at 2-inch depth and offset 6 inches horizontally from the non-wheel and wheel furrow bottoms were taken on September 19 from each replicate of each treatment. Four penetrometer readings were also taken in the same locations in each replicate. PAM-treated and untreated furrow shapes in two dimensions were

measured using a drop rod measuring device on September 20. Each shape is an average of four measurements taken in close proximity in the same furrow.

## Results and Discussion

The average soil water potential in the potato hills at 8-inch depth for the PAM-treated and untreated plots followed a similar pattern during the season (Figure 1).

Treatment of irrigation water with PAM did not result in any significant difference in potato yield or grade in 1995 (Tables 1 and 2). PAM-treated irrigation water was associated with lighter frying tubers over all varieties (Table 3).

There was no significant difference in soil bulk density between the PAM-treated and untreated plots. The PAM-treated non-wheel furrows had lower penetrometer readings than the untreated non-wheel furrows (2.8 and 3.7 $kg/cm^2$ for PAM and non-PAM, respectively, significant at the $P = 0.02$ level). At the end of the season, the untreated wheel furrows at the bottom of the field were shallower than the PAM-treated wheel furrows (Figure 2). The shallower furrows in the untreated plots suggest soil movement and deposition from the top of the field and soil redistribution from the sides to the bottom of the potato hills. Since PAM was effective in maintaining a deep furrow, the depth of water in the PAM-treated furrows during irrigations was probably less than in the untreated furrows resulting in less effective wetting of the hill. Further research to determine the appropriate furrow shape to be used with PAM-treated water could improve the wetting of the hills.

The patterns of petiole nitrate over time were similar between the PAM-treated and untreated plots for each of the three varieties (Figure 3).

## Literature cited

Shock, C.C., J. Zattiero, K. Kantola, and Lamont Saunders, 1995. Oregon State University Agricultural Experiment Station Special Report 947. pp. 128-137.

Terry, R.E. and S.D. Nelson. 1986. Effects of Polyacrylamide and irrigation method on soil physical properties. Soil Science, V 141, #5, pp. 317-320.

Wallace, A., G.A. Wallace, and A.M. Abouzamzam. 1986. Effects of soil conditioners on water relationships in soils. Soil Science, V. 141, #5 pp. 346-352.

Table 1. Yield response of four potato cultivars to PAM-treated irrigation water. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1995.

| Variety | Treatment | Potato yield by market grade | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | US Number One | | | | US Number Two | | | | Marketable | Undersize | Total yield |
| | | 4-6 oz | 6-10 oz | >10 oz | total | 4-6 oz | 6-10 oz | >10 oz | Total | | | |
| | | cwt/ac | | | | | | | | | | |
| R. Burbank | No PAM | 106.4 | 170.2 | 152.2 | 428.8 | 6.3 | 16.8 | 30.8 | 53.8 | 482.6 | 80.6 | 563.2 |
| | PAM | 112.2 | 148.6 | 119.1 | 379.9 | 3.8 | 11.3 | 14.6 | 29.6 | 409.5 | 82.6 | 492.1 |
| | Average | 109.3 | 159.4 | 135.7 | 404.3 | 5.1 | 14.0 | 22.7 | 41.7 | 446.1 | 81.6 | 527.7 |
| Shepody | No PAM | 33.1 | 91.5 | 312.8 | 437.4 | 1.8 | 2.9 | 29.7 | 34.5 | 471.9 | 19.2 | 491.1 |
| | PAM | 22.3 | 73.4 | 314.4 | 410.1 | 0.0 | 1.7 | 20.0 | 21.7 | 431.9 | 16.7 | 448.5 |
| | Average | 27.7 | 82.5 | 313.6 | 423.8 | 0.9 | 2.3 | 24.9 | 28.1 | 451.9 | 17.9 | 469.8 |
| F. Russet | No PAM | 72.8 | 137.5 | 191.0 | 401.3 | 2.0 | 5.5 | 24.1 | 31.6 | 432.8 | 52.5 | 485.3 |
| | PAM | 73.8 | 132.5 | 221.6 | 427.8 | 1.0 | 1.8 | 15.5 | 18.3 | 446.1 | 52.4 | 498.5 |
| | Average | 73.3 | 135.0 | 206.3 | 414.6 | 1.5 | 3.6 | 19.8 | 24.9 | 439.5 | 52.4 | 491.9 |
| R. Russet | No PAM | 42.4 | 110.3 | 271.5 | 424.2 | 1.2 | 7.6 | 25.0 | 33.8 | 458.1 | 27.2 | 485.3 |
| | PAM | 45.0 | 128.5 | 242.3 | 415.8 | 3.3 | 9.9 | 22.2 | 35.4 | 451.2 | 46.4 | 497.6 |
| | Average | 43.7 | 119.4 | 256.9 | 420.0 | 2.2 | 8.8 | 23.6 | 34.6 | 454.6 | 36.8 | 491.4 |
| All varieties | No PAM | 63.6 | 127.4 | 231.9 | 422.9 | 2.8 | 8.2 | 27.4 | 38.4 | 461.3 | 44.9 | 506.2 |
| | PAM | 63.3 | 120.8 | 224.4 | 408.4 | 2.0 | 6.2 | 18.1 | 26.2 | 434.7 | 49.5 | 484.2 |
| LSD (0.05) Trt | | ns | ns | ns | ns | ns | ns | 7.6 | 12.5 | ns | ns | ns |
| LSD (0.05) Variety | | 11.2 | 14.3 | 33.7 | ns | 2.3 | 4.9 | ns | 12.3 | ns | 38.6 | 38.4 |
| LSD (0.05) Trt X var | | ns | 20.2 | ns | ns | ns | ns | ns | ns | ns | ns | ns |

Table 2. Market grade distribution response of four potato cultivars to PAM-treated irrigation water. Malheur Experiment Station, Oregon State University, Ontario, OR, 1995.

| Variety | Treatment | Potato market grade distribution | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | US Number One | | | | US Number Two | | | | Marketable | Undersize |
| | | 4-6 oz | 6-10 oz | >10 oz | total | 4-6 oz | 6-10 oz | >10 oz | total | | |
| | | % | | | | | | | | | |
| R. Burbank | No PAM | 19.2 | 30.3 | 26.4 | 75.9 | 1.2 | 3.0 | 5.4 | 9.5 | 85.5 | 14.5 |
| | PAM | 22.8 | 30.3 | 24.2 | 77.2 | 0.8 | 2.3 | 2.9 | 5.9 | 83.2 | 16.8 |
| | Average | 21.0 | 30.3 | 25.3 | 76.6 | 1.0 | 2.6 | 4.2 | 7.7 | 84.3 | 15.7 |
| Shepody | No PAM | 6.8 | 18.8 | 63.6 | 89.1 | 0.4 | 0.6 | 6.0 | 6.9 | 96.0 | 4.0 |
| | PAM | 5.0 | 16.7 | 69.6 | 91.3 | 0.0 | 0.4 | 4.6 | 4.9 | 96.2 | 3.8 |
| | Average | 5.9 | 17.8 | 66.6 | 90.2 | 0.2 | 0.5 | 5.3 | 5.9 | 96.1 | 3.9 |
| F. Russet | No PAM | 15.0 | 28.4 | 39.1 | 82.5 | 0.4 | 1.2 | 5.0 | 6.6 | 89.1 | 10.9 |
| | PAM | 14.8 | 26.7 | 44.3 | 85.8 | 0.2 | 0.3 | 3.1 | 3.6 | 89.4 | 10.6 |
| | Average | 14.9 | 27.5 | 41.7 | 84.2 | 0.3 | 0.7 | 4.0 | 5.1 | 89.3 | 10.7 |
| R. Russet | No PAM | 8.9 | 22.7 | 55.8 | 87.3 | 0.2 | 1.5 | 5.2 | 7.0 | 94.3 | 5.7 |
| | PAM | 9.4 | 26.2 | 48.5 | 84.1 | 0.7 | 2.0 | 4.6 | 7.3 | 91.4 | 8.6 |
| | Average | 9.1 | 24.4 | 52.1 | 85.7 | 0.5 | 1.8 | 4.9 | 7.2 | 92.9 | 7.1 |
| All varieties | No PAM | 12.5 | 25.0 | 46.2 | 83.7 | 0.5 | 1.6 | 5.4 | 7.5 | 91.2 | 8.8 |
| | PAM | 13.0 | 25.0 | 46.7 | 84.6 | 0.4 | 1.3 | 3.8 | 5.4 | 90.0 | 10.0 |
| LSD (0.05) Trt | | ns | ns | ns | ns | ns | ns | 1.4 | 1.9 | ns | ns |
| LSD (0.05) Variety | | 2.2 | 2.9 | 4.5 | 2.8 | 0.5 | 0.9 | ns | ns | 2.5 | 2.5 |
| LSD (0.05) Trt X Var | | ns | ns | 6.3 | ns | ns | ns | ns | ns | ns | ns |

Table 3. Tuber quality response of four potato cultivars to PAM-treated irrigation water. Malheur Experiment Station, Oregon State University, Ontario, OR, 1995.

| Variety | Treatment | Stem-end fry reflectance color | Specific gravity |
|---|---|---|---|
| | | % | |
| R. Burbank | No PAM | 33.2 | 1.09 |
| | PAM | 35.4 | 1.09 |
| | Average | 34.3 | 1.09 |
| Shepody | No PAM | 46.4 | 1.09 |
| | PAM | 48.9 | 1.09 |
| | Average | 47.7 | 1.09 |
| F. Russet | No PAM | 32.9 | 1.09 |
| | PAM | 34.9 | 1.09 |
| | Average | 33.9 | 1.09 |
| R. Russet | No PAM | 45.5 | 1.1 |
| | PAM | 45.7 | 1.1 |
| | Average | 45.6 | 1.1 |
| All varieties | No PAM | 39.5 | 1.09 |
| | PAM | 41.2 | 1.09 |
| LSD (0.05) Trt | | 1.1 | ns |
| LSD (0.05) Variety | | 1.9 | 0 |
| LSD (0.05) Trt X Var | | ns | ns |

Figure 1. Soil water potential over time at 8-inch depth in potato hills furrow irrigated with PAM-treated and untreated water. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1995.

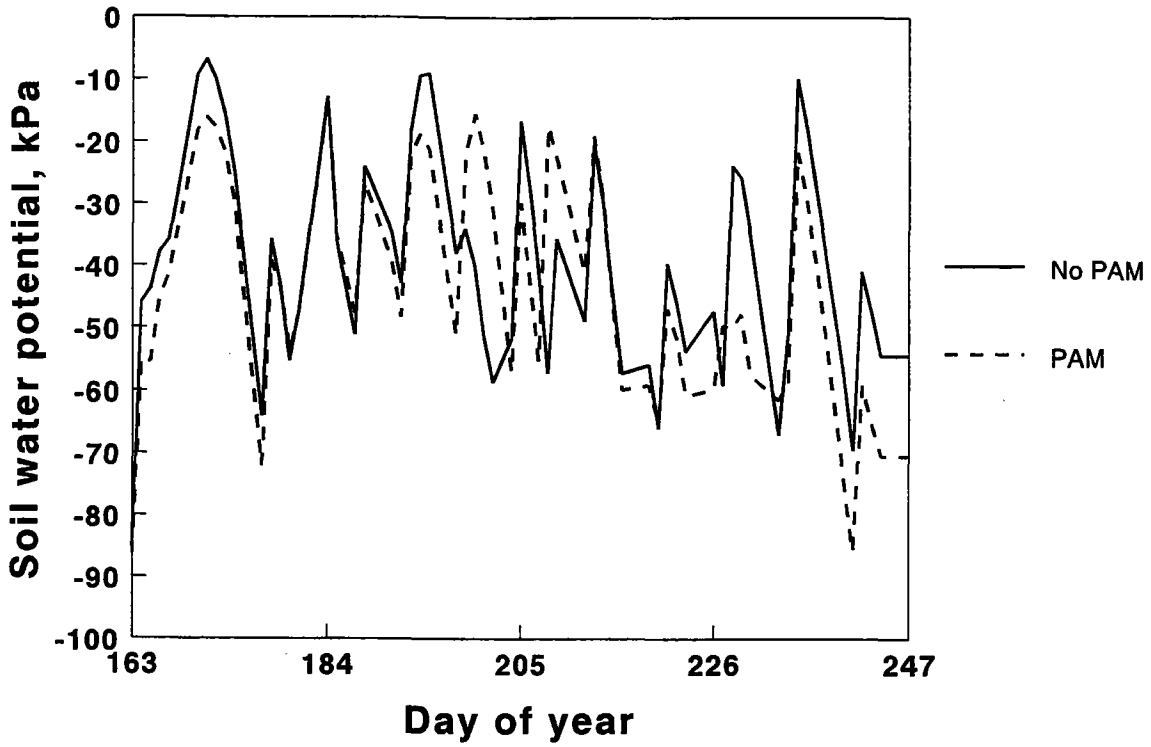


Figure 2. Furrow shapes at the field bottom (400' from top, wheel furrows). Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1995.

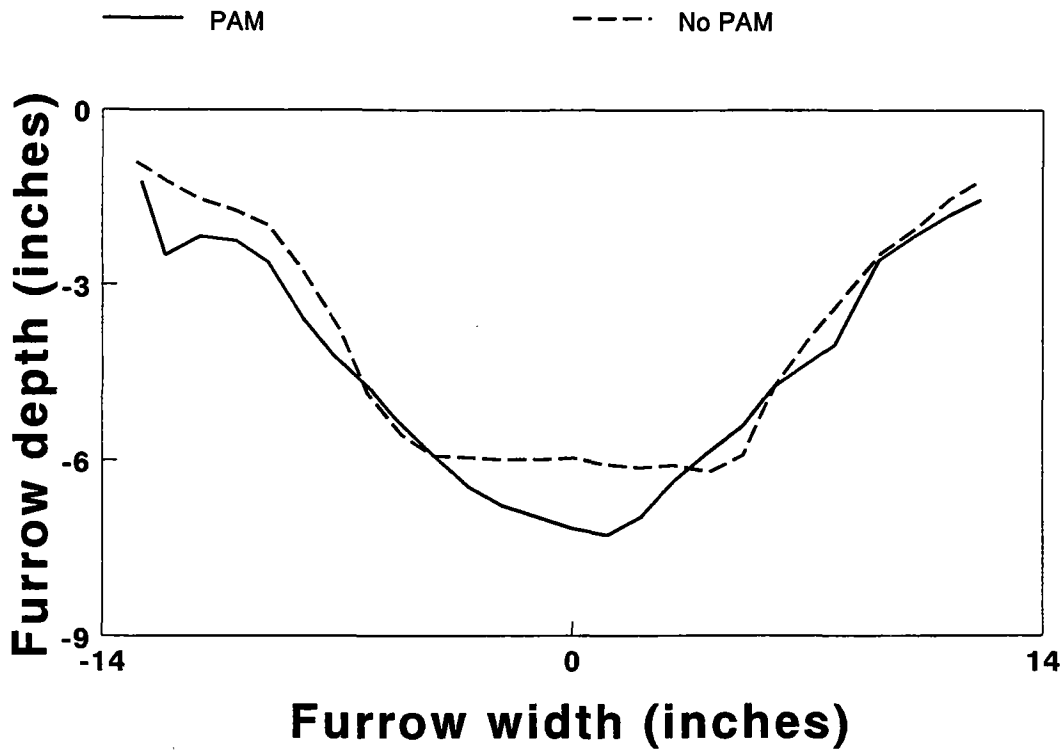

Figure 3. Petiole nitrate over time for Russet Burbank, Shepody and Frontier Russet plants. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1995.