Polymer Use to Slow N-Leaching in Furrow Irrigated Corn – 2006
Merrick County, NE

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Rationale

Year after year, corn producers in the coarse-textured Central Platte Valley of Nebraska face the challenge of adequately supplying nutrients to maximize their crop yields while trying to prevent the leaching of soluble fertilizers into the underlying aquifer. Of primary concern is nitrate loss to groundwater. Producers are always searching for economical and effective measures to achieve greater N use efficiency while minimizing loss of N to the environment.

Soil-applied cross-linked polymer

A new tool being examined is a water-absorbing (or hydrophilic) polymer product. This soil applied polymer is marketed to theoretically increase the water-holding capacity of the soil, thereby helping to reduce N leaching from well-drained soils. This product is basically the same ingredient that is in disposable diapers to absorb that moisture. This environmentally safe, finely ground plastic can absorb up to five hundred times its weight in water.

Water-applied polyacrylamide (PAM)

Another polymer product being tested is an environmentally safe, food-grade compound known as polyacrylamide, or PAM. PAM is a chemical soil stabilizer. Past research has shown that only a few pounds/acre of this polymer can help control sediment runoff and erosion in furrow irrigated production. PAM in irrigation water retards soil surface sealing and also generally increases net infiltration and lateral movement of infiltrated water.

Procedures & Plot Set-up

To directly compare these polymer products, a study was conducted on a cooperator's field in Merrick County in 2006, in collaboration with the Central Platte Natural Resources District (CPNRD). The soil types present were Janude sandy loam (Jm) and Fonner sandy loam (Fn) (Figure 1). This 15-acre site was furrow-irrigated corn. Management practices (hybrid selection, fertilizer other than N, pesticides, irrigation, etc.) were at the discretion of the cooperator with the intent to optimize yield potential.

The study evaluated the effects of the cross-linked polymer at the rate of 30 lb/acre in bands 8 inches apart on soil moisture and root zone nitrate-N during the growing season, and grain yield at harvest. Treatments were applied in replicated field length strips preplant (April 13, 2006), and included an untreated check, as well as a surface-applied polyacrylamide (PAM) treatment in the irrigation water stream. Polymer was also hand-applied to small plots to test the effects of various polymer rates (30, 60, 180, 500 lb/ac).

Figure 1. 2006 Study location (furrow-irrigated field)

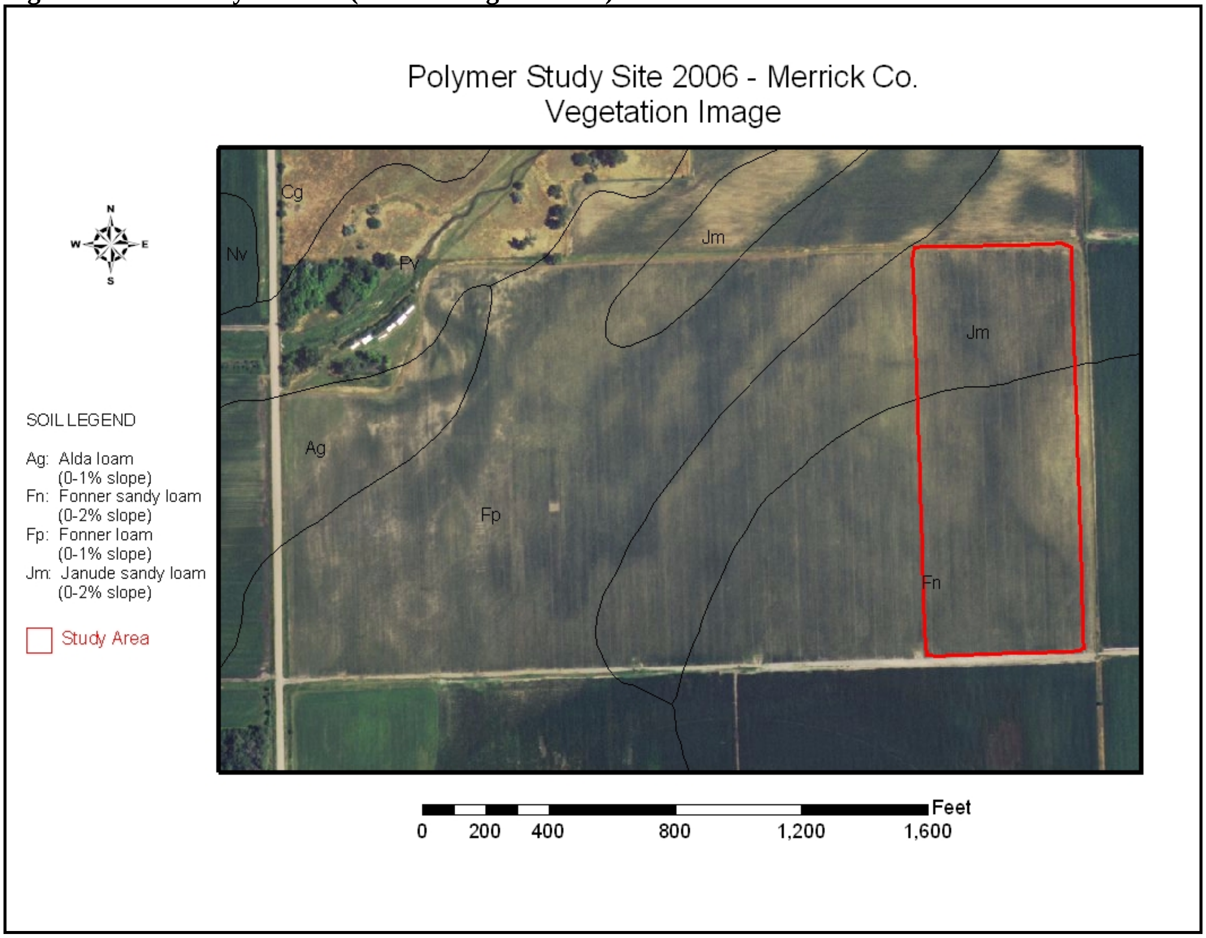


Figure 2. No-till drill application of polymer to field

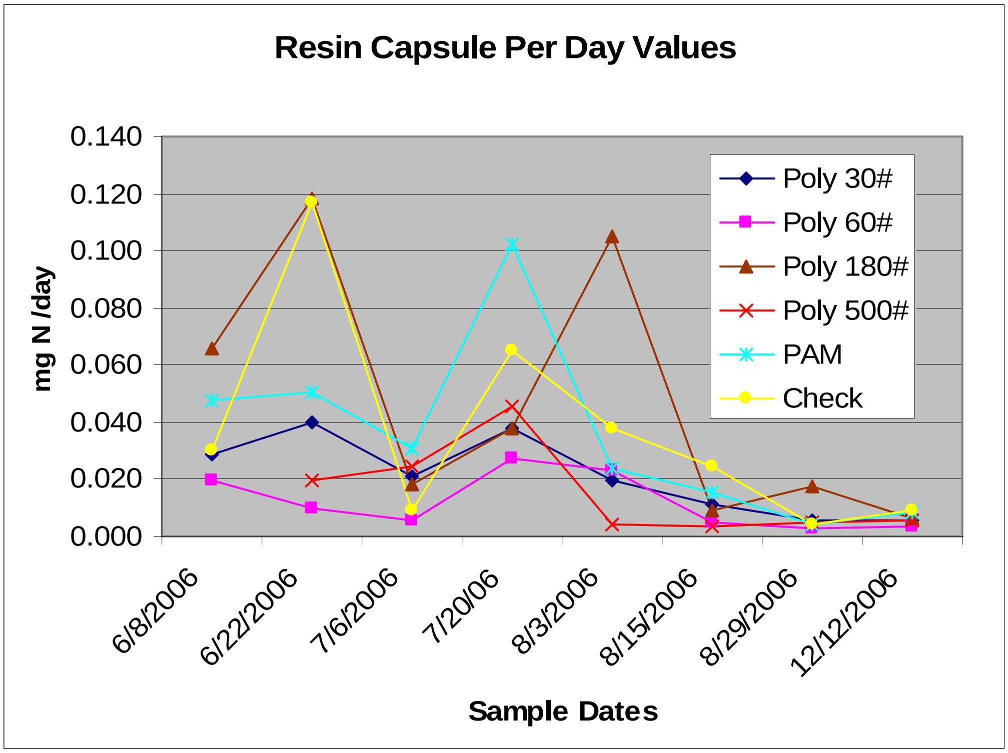
Figures 3 & 4. Hand-application of polymer to small plots

Equipment was installed at this site to monitor weather conditions, crop status, and soil moisture throughout the growing season. Continuous weather data was collected from an on-site weather station, and constant 18-inch soil moisture was collected with Watermark® granular matrix sensors and loggers. Weekly leaf chlorophyll readings (Minolta SPAD® meter) and 3.3 ft soil profile moisture readings (Sentek Diviner 2000®, capacitance sensor) were collected. Mixed bed ion exchange resin capsules, installed to absorb nitrate at a 3 ft soil depth, were retrieved and replaced every 14 days.

Results:

Initial stand counts showed an average corn stand of 26,892 plants per acre (no significant difference among treatments). Rainfall during the Apr. 1 through Oct. 1, 2006 growing season totaled 16.92 inches (89% of normal). This was supplemented with 19.31 inches of irrigation water (7 events). Small plots were hand-harvested Sept. 20, 2006 and the grain was analyzed for total N content. The field-length strips were harvested Oct. 25, 2006. A yield-monitor collected spatial yield across the field, and a weigh wagon collected total strip weights.

Figure 5. Resin capsule N recovery per day at 36" depth.



Resin Capsules

Nitrate-N recovery in this study was very low in 2006 (Figure 5). This was true across all treatments, especially later in the growing season. The small spikes in N recovery may have been in response to a 3.6 inch rainfall June 16, and a 2.35 inch rain July 10, in addition to irrigation events in July. There were no significant differences in nitrate-N recovery at the bottom of the root zone among treatments.

Soil Moisture

All treatments showed similar soil moisture trends during the growing season.

Grain Yield

There was a slight trend, though statistically insignificant at the 5% confidence level, toward yield increase with the PAM and polymer treatments compared to the untreated check (Table 1), for combine harvest yields. There was also a trend, though not statistically significant, for higher polymer rates to decrease grain yield, as measured by hand harvesting small plots.

Table 1. Grain yield, moisture, grain N, grain oil and grain starch content.

			Small Plot Hand Harvest (9/20/2006)				Machine Harvest (10/25/2006)	
Strip Trt No.	Soil Amendment	Polymer Rate (lb/acre)	Dry Grain Yield (bu/ac)	Grain Total N (%)	Grain DM Oil (%)	Grain DM Starch (%)	Dry Grain Yield (bu/ac)	Grain Moist (%)
1	Check	--					190.4 a	16.1
2	PAM	--					192.9 a	16.1
3	Polymer	30					197.2 a*	16.0
	Polymer Small plots	30	223.3 a	1.43	3.93	70.51		
		60	222.2 a	1.44	3.94	70.49		
		180	220.7 a	1.41	3.97	70.60		
		500	218.1 a	1.42	3.81	70.73		
Effects with the same letter are not different at the 0.05 level of significance *Different at the 0.12 level of significance Overall field average=193.5 bu/ac (machine harvest)								

The study will be continued in 2007 to investigate residual effects of treatments with irrigated corn.