INORGANIC NITROGEN FERTILIZER AND PELLETED POULTRY LITTER INCREASE CORN YIELD

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BACKGROUND INFORMATION AND RESEARCH PROBLEM

Nitrogen is the most limiting nutrient in corn (*Zea mays* L.) production. Corn acreage in Arkansas has almost doubled in recent years, making it an important source of income for farmers. Improved nitrogen (N) fertilization practices can increase net profits to corn growers and prevent unnecessary input of the nutrients into the environment. Introduction of pelleted poultry litter (PPL) to corn production systems in the Mississippi Delta Region of Arkansas (MDRA) is an area of corn fertilization that needs to be addressed. Pelleted poultry litter contains N, phosphorus (P), potassium (K), and small quantities of micronutrients. However, there is virtually no information on corn and soil response to PPL in the MDRA. A field experiment was conducted to compare corn N response to a range of N rates applied as inorganic-N fertilizer (INF) and PPL. The objectives of this study were to evaluate the effect of PPL and inorganic N-fertilizer rate on corn grain yield and soil properties in a typical MDRA soil.

PROCEDURES

A replicated field experiment was conducted at the University of Arkansas Cotton Branch Experiment Station (CBES) in Marianna, Ark., on a Loring silt loam during the 2004 growing season. Standard tillage and other cultural practices recommended by the University of Arkansas Cooperative Extension Service for corn production were followed. Experimental variables were N source and N rate. Inorganic-N fertilizer (INF) and PPL (4.05% N) were each applied at a range of N rates. Inorganic-N fertilizer was applied at 50, 100, 150, 200, and 250 lb N/acre and PPL was applied at bulk rates of 1500, 3000, 4500, and 6000 lb/acre, which correspond to about 60, 120, 180, and 240 lb total-N /acre. An unfertilized control (0 lb N/acre) was also included. All INF treatments received a preplant application of 20 lb N/acre as ammonium sulfate prior to planting and the balance of the INF was sidedressed as urea when plants were 6 weeks old. All of the PPL treatments were applied before planting and mechanically incorporated. All plots were also fertilized with 80 lb P_2O_5/acre as triple superphosphate and 60 lb K_2O/acre as muriate of potash to ensure that yield was not limited by K or P deficiency. All preplant amendments were broadcast and mechanically incorporated. Experimental plots were 40-ft long and 12.6-ft wide allowing for four rows of corn planted in 38-inch wide rows. The corn cultivar Pioneer 32p76BT was planted on 9 April 2004 and harvested with a plot combine on 1 September 2004. Grain yield was adjusted to a uniform moisture content of 15% for statistical analysis.

After harvest, composite soil samples were collected from the 0- to 6-inch depth of all plots. Soil samples were extracted with Mehlich-3 solution (1:10 ratio) and the concentration of elements in the extract was measured by inductively coupled plasma atomic emission spectroscopy. Soil-nitrate N was extracted with 0.025 *M* aluminum sulfate and measured with a specific-ion electrode. Soil pH was measured by electrode in a 1:2 (weight:volume) soil-water mixture extraction. Treatments were arranged in a ranodmized complete block design with four replications of each treatment. Analysis of variance (ANOVA) was performed to evaluate the effect of inorganic-N fertilizer and PPL N rate on corn grain yield and soil chemical properties.

RESULTS AND DISCUSSION

Pelletized litter rates of 120 to 240 lb N/acre produced greater yields than the unfertilized control that were similar to INF rates of 50 lb N/acre (Table 1). Inorganic-N fertilizer rates ≥150 lb N/acre all produced significantly greater yields than the highest PPL-N rate, suggesting that PPL alone would not be capable of supplying the N requirement for corn. Soil NO_3-N at the highest rates of PPL and INF-N was significantly higher than the untreated check (Table 2). At the highest rates of PPL, Mehlich-3-extractable P, K, and Cu were significantly greater than the unfertilized control and most INF rates.

PRACTICAL APPLICATIONS

Application of inorganic-N fertilizer or PPL increased corn yields, but maximal yields were produced only by inorganic-N fertilizer. Data suggest that PPL may serve as a starter N when P-based rates (1500 to 3000 lb/acre) are applied, but will require the application of supplemental inorganic-N for maximal yields to be achieved. This single site-year of data suggests that corn growers who use PPL will also benefit from the addition of other nutrients. However, additional research is needed to delineate agronomically and environmentally sound PPL application rates to avoid over-application and accumulation of some nutrients in the soil.

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Table 1. Effect of application of inorganic-N fertilizer (INF) and pelleted poultry litter (PPL) on corn grain yields at the Cotton Branch Experiment Station (CBES) in 2004.

N source	PPL rate	Total-N rate	Corn yield
	(lb PPL/acre)	(lb N/acre)	(bu/acre)
Control	0	0	68
INF[z]	0	50	120
INF	0	100	134
INF	0	150	153
INF	0	200	161
INF	0	250	151
PPL[y]	1500	60	79
PPL	3000	120	124
PPL	4500	180	120
PPL	6000	240	113
MSD[x] at 0.05	--	--	20

[z] For inorganic-N fertilizer, the first 20 lb N/acre was applied as ammonium sulfate and the rest was applied as urea.
[y] PPL = Pelleted poultry litter.
[x] Minimum significant difference as determined by Waller-Duncan Test (P=0.05).

Table 2. Effect of inorganic-N fertilizer (INF) and pelleted poultry litter (PPL) on soil chemical properties of soil collected post-harvest from the 0- to 6-inch depth of the corn experiment at the Cotton Branch Experiment Station in 2004.

	Total	Soil	Soil	Soil	Mehlich-3-extractable nutrients					
N source	N rate	pH[z]	OM[y]	NO_3-N[x]	P	K	Ca	Mg	Cu	Zn
	(lb/acre)		(%)		---------- (lb/acre) ----------					
None	0	6.8	1.8	11	108	301	2750	451	2.9	9.4
INF	50	6.4	1.6	10	93	265	2484	462	2.6	7.5
INF	100	6.6	1.6	9	104	268	2545	431	3.0	10.6
INF	150	6.6	1.7	11	103	248	2542	469	3.0	9.4
INF	200	6.7	1.5	14	104	271	2908	413	3.2	7.1
INF	250	6.4	1.5	15	89	231	2501	448	2.8	6.8
PPL	60	6.8	1.6	13	122	320	2712	464	3.2	10.9
PPL	120	6.7	1.5	14	138	370	2510	444	3.4	9.5
PPL	180	6.8	1.7	12	130	354	2871	438	3.8	11.8
PPL	240	6.9	1.7	16	172	412	3501	439	4.0	11.8
MSD at 0.05[w]		NS	NS	4	40	64	NS	NS	0.6	4.3

[z] Soil pH was measured in a 1:2 (weight:volume) soil-water mixture.
[y] OM, soil organic matter determined by Weight Loss on Ignition.
[x] NO_3-N measured by ion-specific electrode.
[w] Minimum significant difference as determined by Waller-Duncan Test (NS, not significant at $P = 0.05$).