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EFFECT OF AMMONIUM:NITRATE RATIOS ON SWEETCORN YIELD AND SOIL NITROGEN CONCENTRATIONS

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Background. Environmental agencies and the population in general are becoming concerned about the potential of fertilizers to contaminate surface and ground waters with nitrates. Numerous shallow aquifers throughout Texas are used by people who live in rural areas. Some of these aquifers are at risk for nitrate (NO_3^-) contamination. Methodologies are needed which improve crop N uptake and decrease the potential NO_3^- contamination of shallow aquifers.

One possible means for lowering the risk of NO_3^- pollution in ground waters may be to increase the proportion of plant available N in the ammonium (NH_4^+) form. The main objective of this study is to determine the effect of variable NH_4^+:NO_3^- fertilization on sweet corn yield, N uptake, and soil residual inorganic N.

Research Findings. This study is being conducted on a Bowie fine sandy loam near Overton. Supplemental P, K, Mg, S, B, Cu, and Zn were added to the soil. The experimental site was subdivided into 4 replications of 7 treatments applied to 20 x 13.33 ft plots. A control plot received no N. One plot received all the N preplant in the form of ammonium nitrate fertilizer. Treatments 3 through 7 were treated with solutions containing NH_4^+:NO_3^- ratios that varied from zero ammonium nitrogen with 100% of the N applied as calcium nitrate, to 100% NH_4^+ with no NO_3^-. Ratios were 0:100, 25:75, 50:50, 75:25, and 100:0 $NH_4^+NO_3^-$. Solutions at these ratios were applied by pressure injection through leaky pipe 6 times at 25 lb increments of N/ac at each application. Soil samples were collected from the 0- to 15-, 15- to 30-, and by 30-cm depths to 150-cm deep in each plot. Samples were dried and analyzed for residual NH_4^+ and NO_3^-N. Harvests were made June 22 and 29.

Yield of the whole plant, ear weight, and number of ears per plant were not significantly affected by N treatment or NH_4^+:NO_3^- ratio (data not shown). Nitrate-N content in the 0- to 15- and 15- to 30-cm depths was increased by increasing the percent NO_3^- in the mixture (Table 1). Control plots were low in NO_3^--N. The total N applied preplant as NH_4NO_3 increased NO_3^--N in the 0- to 15-cm depth to a level that approximated NO_3^- in the soil from the 50:50 NH_4^+:NO_3^- mixture. A low concentration of NO_3^- was found at all depths below 30 cm.

Soil ammonium concentrations increased as the percentage of NH_4^+-N in the blended solutions increased (Table 2). More NH_4^+-N was found in the lower soil depths than was NO_3^--N. The sum of the NH_4^+ and NO_3^--N levels by depths and treatments showed the reason no differences in yield were detected. The levels of NH_4^+ plus NO_3^--N in the total soil depth were high and similar for all treatments, including the unfertilized check plot soil.

Application. One interesting observation from this study is that soil NH_4^+-N levels were generally higher than the NO_3^--N levels in the post-harvest soil samples. There was substantially more soil NH_4^+ than NO_3^- in the soil profile from 30- to 150-cm deep. Leaching of NO_3^- in these sandy soils in spring and summer may not be as serious as was anticipated. Accumulation of NH_4^+ in these deeper depths may be due to soil acidity preventing the increase of the nitrifying bacteria.

Table 1. Effect of NH_4^+:NO_3^- ratio on the NO_3-N content in the 0- to 15- and 15- to 30-cm depths at 3 sampling times and on profile NO_3-N after the final harvest. TVA study - 1992.

Treatment	5/29	6/19	Postharvest	5/29	6/19	Postharvest	
NH_4^+:NO_3^-	0-15 cm			15-30 cm			30-150 cm
%	ppm						
Control (0 N)	0.5 c†	0.2B	3.5 B	1.0 d	1.4 c	1.1 b	1.4 NS
Preplant NH_4NO_3	7.7 bc	12.1 b	13.1 a	10.1 bc	8.1 bc	2.6 b	2.3 NS
0:100	23.6 a	33.7 a	12.9 a	22.4 a	34.7 a	11.9 a	4.2 NS
25:75	21.1 a	15.2 b	8.5 ab	23.9 a	15.8 b	7.0 b	4.1 NS
50:50	10.8 b	12.9 b	9.8 ab	13.1 b	10.7 bc	6.5 b	3.2 NS
75:25	5.4 bc	6.8 b	4.5 b	9.4 bc	7.4 bc	4.5 b	1.6 NS
100:0	1.2 c	3.3 b	4.3 b	3.9 cd	3.4 c	5.1 b	2.8 NS
R^2	0.86	0.79	0.65	0.85	0.85	0.66	
C.V.	43.9	55.4	44.8	35.3	51.8	54.2	

†NO_3-N levels followed by a similar letter within a column are not different statistically at the $p = 0.05$ level.

Table 2. Effect of NH_4^+:NO_3^- ratio on the NH_4-N content in the 0- to 15- and 15- to 30-cm depths at 3 sampling times and on profile NH_4-N after the final harvest. TVA study - 1992.

Treatment	5/29	6/19	Postharvest	5/29	6/19	Postharvest	
NH_4^+:NO_3^-	0-15 cm			15-30 cm			30-150 cm
%	ppm						
Control (0 N)	5.0 c†	7.7‡	21.3‡	7.5 b	4.9 b	4.4‡	41.3‡
Preplant NH_4NO_3	7.1 c	13.1	5.4	6.8 b	4.7 b	3.5	49.8
0:100	7.5 c	7.0	4.3	5.6 b	13.7 ab	5.9	32.7
25:75	14.6 bc	3.7	6.0	9.3 b	6.3 b	7.0	19.9
50:50	14.9 bc	6.8	24.0	11.0 b	6.3 b	6.0	21.5
75:25	22.9 ab	23.2	11.0	13.6 ab	12.7 ab	0.2	62.2
100:0	29.8 a	23.5	15.3	21.3 a	19.8 a	8.0	30.0
R^2	0.76	0.42	0.48	0.63	0.61	0.2	
C.V.	42.7	96.4	102.4	50.8	57.1	83.0	

†NH_4-N levels followed by a similar letter within a column are not different statistically at the $p = 0.05$ level.
‡Indicates no statistically significant differences due to treatment.