THE EFFECT OF AMMONIUM TO NITRATE RATIOS OF FERTILIZERS APPLIED AT VARIOUS TIMES THROUGHOUT THE GROWING SEASON ON YIELD AND NITROGEN CONCENTRATION OF CORN[1]

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A number of recent investigations have produced evidence that the ionic form of N taken up by roots affects the growth of plants. While soil-grown plants generally take up most of their N as nitrate, there is evidence that increasing the relative proportion of ammonium in the culture (or soil) solution can enhance growth and yield. Owing to difficulties in preventing the rapid microbial conversion of ammonium to nitrate in soil, this response has not been well demonstrated in a field situation.

The objective of this study was to evaluate the effect of varying ammonium to nitrate ratios applied at varying times on the yield and nitrogen concentration in corn.

METHODS AND MATERIALS:

The experiment was conducted on a Drummer sicl on the Agronomy South Farm, Urbana, IL during the 1987 growing season. Prior to planting, drip hose was buried at a depth of 7 inches on 30 inch centers directly under the center two corn rows of those plots which were to receive nitrogen during the growing season. Pioneer Brand 3377 was planted on 1 May, 1987 and after emergence was thinned to a final stand of 27,000 plants per acre. On 27 May, anhydrous ammonia was applied at rates of 80, 160, 240, and 320 lbs N/acre with and without nitrapyrin. Two additional ammonia treatments at the 160 lbs N/acre rate were included to evaluate the effect of water and water plus nitrapyrin applied in the drip tube treatments. The remaining 10 treatments consisted of application of 160 lbs N/acre through the drip tubes using urea, ammonium nitrate, potassium nitrate, or combinations as shown in Table 1.

Plant samples consisting of the whole plant and the lower 4 inches of the stalk were collected at V10. Ear leaf and lower 4 inches of stalk samples were collected at R1 and R4. Whole plant samples were collected at harvest. All samples will be analyzed for total N, and in addition the stalk samples will be analyzed for ammonium and nitrate N. At R1, exudate from the cut stump was collected for ammonium, nitrate, and total N analysis. Grain and total dry matter harvest was made on 23 Sept.

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RESULTS AND DISCUSSION:

The design of the study allows for comparison of three distinct factors. These include the effect of rate of sidedressed ammonia applied with and without nitrapyrin, the effect of nitrogen source, and the effect of time of application of different nitrogen sources.

Rate of Ammonia Application With and Without Nitrapyrin: Increasing N rates resulted in increased concentration of N in both the stem and leaf tissue at all sampling dates (example of response shown in (Fig. 1). The addition of nitrapyrin with 80 lbs N/acre significantly decreased the N concentration in the stem tissue at all three sampling dates and in the leaf tissue at R4. A yield increase was associated with increasing N rates. Without an inhibitor, yields increased with increasing rates up to 240 lbs N, and with an inhibitor they increased up to 320 lbs N/acre. Other than a few minor exceptions, there were no differences in either N concentration or yield due to the injection of nitrapyrin with sidedressed anhydrous ammonia.

Nitrogen Source: Comparison of soil injected ammonia with and without nitrapyrin, with urea, ammonium nitrate with and without nitrapyrin, and potassium nitrate injected through the drip tubes into the root zone indicated little difference in N concentration in either the stem or leaf tissue at any sampling date. The only exception was a significantly lower concentration in the stem tissue at V10 when potassium nitrate was the N source. Urea fed through the drip tubes produced the highest and potassium nitrate the lowest yield of any nitrogen source used (Fig. 2).

Time of Application of Different Nitrogen Sources: At V10 ammonium nitrate resulted in significantly higher N concentrations in the stem tissue than did potassium nitrate. At the other sampling periods, there were no consistent effect of either time of application or nitrification inhibitor on the N concentration in the stem or leaf tissue. Grain yield was significantly increased when ammonium nitrate was included in the applications at V12-R1 and at R2-R4 as compared to potassium nitrate as the sole source for all application times. Interestingly, ammonium nitrate application at only R2-R4 gave a significantly higher yield than did ammonium nitrate applied at all three times of application including R2-R4 (Fig. 3).

These data tend to indicate that the ionic form of nitrogen taken up by corn may influence yield. However, at this time there does not appear to be a practical method available to apply nitrogen which insures that the plant will obtain the correct proportion of nitrate to ammonium, at the correct time.

Additional data are being collected on total dry matter production, total N uptake, and ammonium and nitrate concentrations in stem tissue and exudate from cut stumps. This study will be conducted again in 1988.

Table 1. Listing of the materials and stage of growth they were applied through drip tubes.

Trt. No.	Time of Application		
	V6	V12-R1	R2-R4
		N Source	
11	KNO_3	KNO_3	KNO_3
12	NH_4NO_3	NH_4NO_3	NH_4NO_3
13	NH_4NO_3 + Nitrapyrin	NH_4NO_3 + Nitrapyrin	NH_4NO_3 + Nitrapyrin
14	Urea	Urea	Urea
15	NH_4NO_3	KNO_3	KNO_3
16	NH_4NO_3 + Nitrapyrin	KNO_3	KNO_3
17	KNO_3	NH_4NO_3	KNO_3
18	KNO_3	NH_4NO_3 + Nitrapyrin	KNO_3
19	KNO_3	KNO_3	NH_4NO_3
20	KNO_3	KNO_3	NH_4NO_3 + Nitrapyrin

FIG. 1 EFFECT OF RATE OF APPLICATION OF AMMONIA WITH AND WITHOUT NITRAPYRIN ON N CONCENTRATION IN THE LOWER 4" OF STALK TISSUE AT R4.

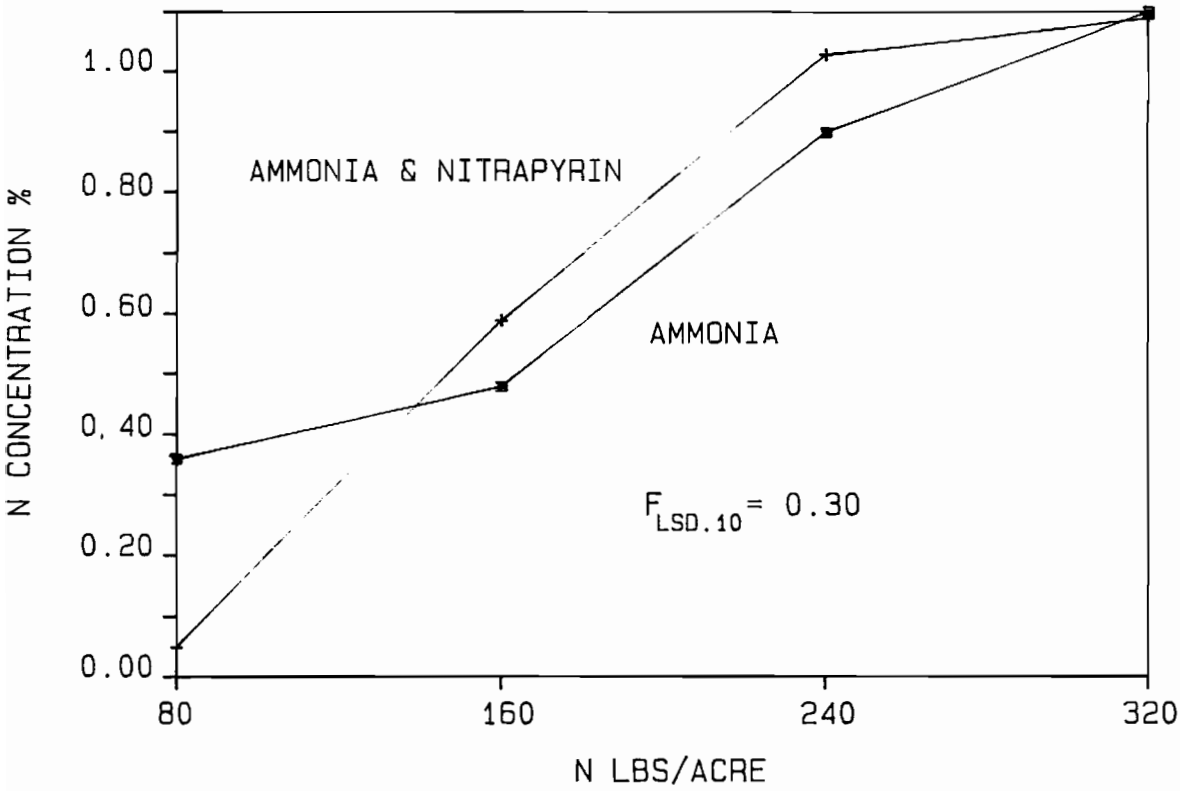


FIG. 2 EFFECT OF N ON CORN YIELD

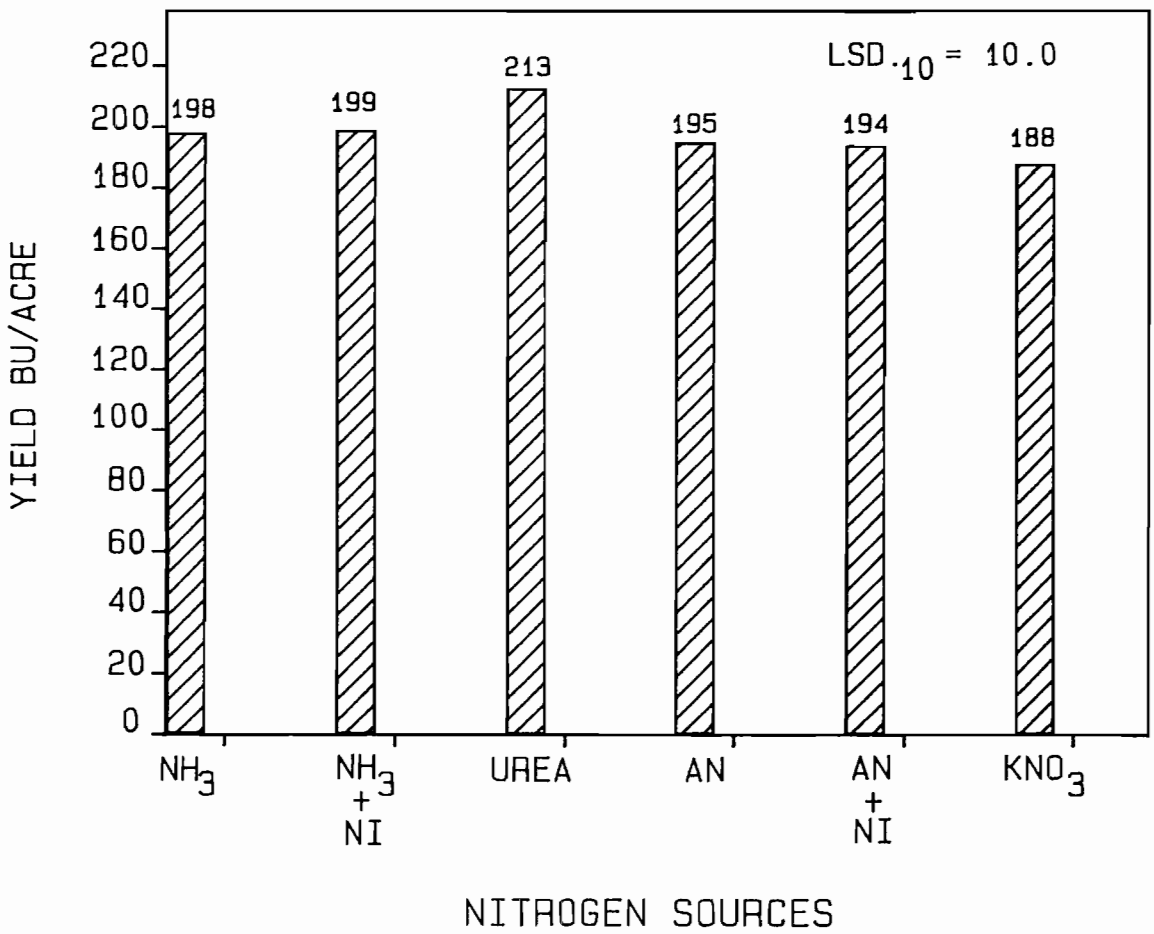
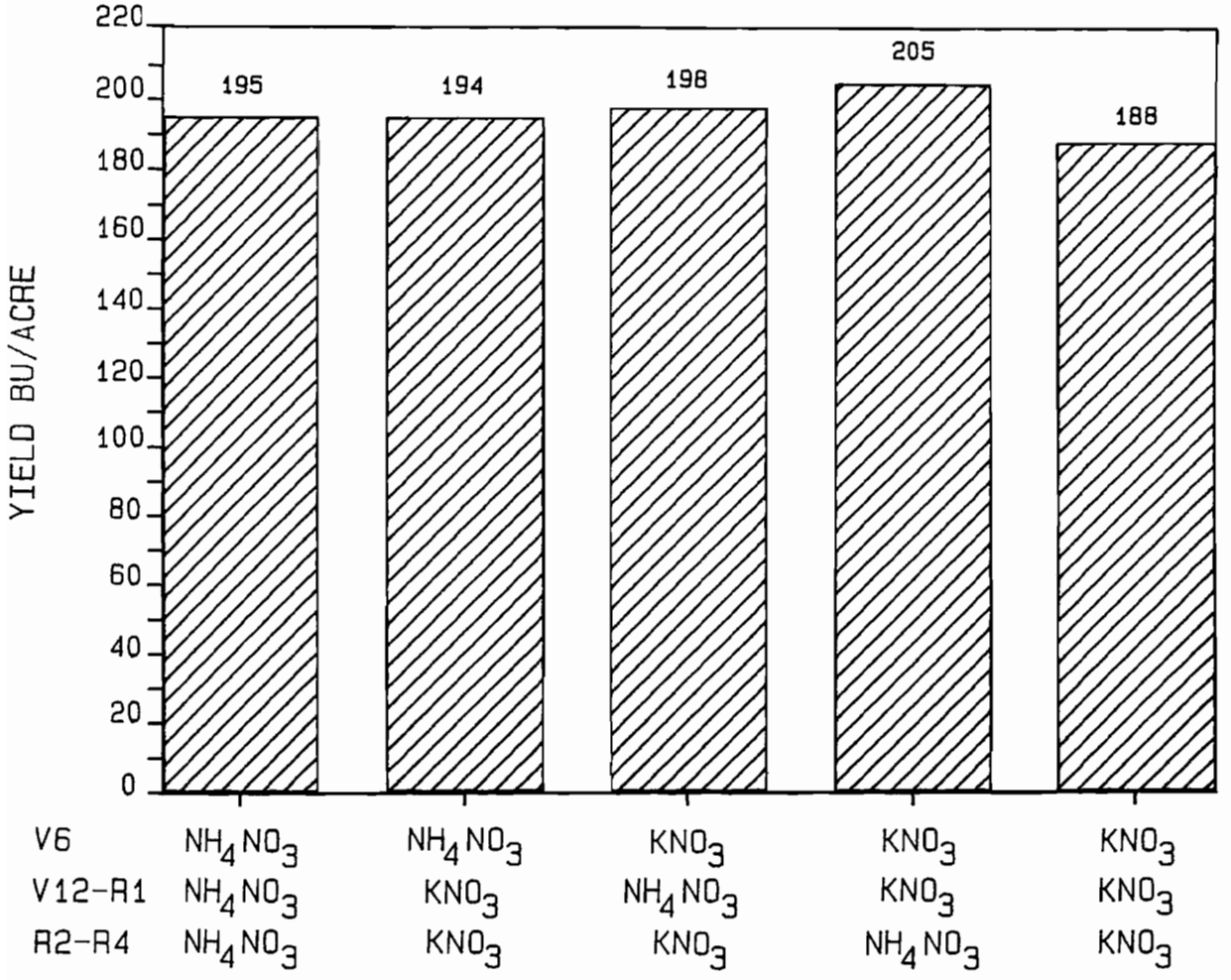


FIG. 3 EFFECT OF TIME OF APPLICATION OF DIFFERENT N SOURCES ON YIELD



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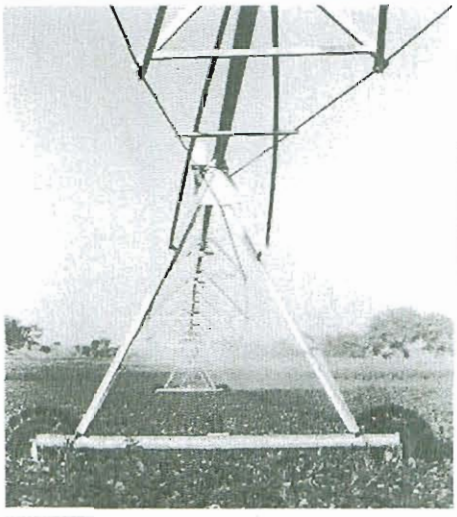
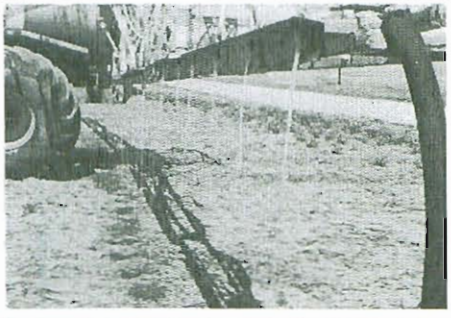
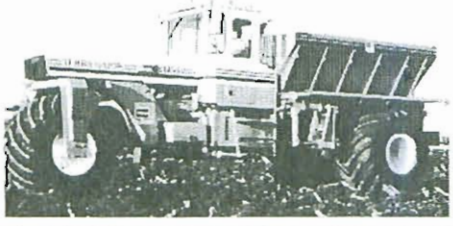
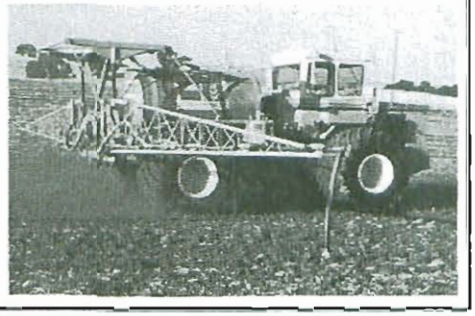

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