

Influence of Nitrogen Fertilizer Placement on Yield Performance of Corn Grown on Single and Twin Rows on an Alluvial Clay Soil

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Introduction

Nitrogen (N) fertilizer placement is an important part of a total fertilizer management program that maximizes N fertilizer use efficiency (NFUE). Cultural practices that enhance NFUE increase profitability, particularly with the current high N fertilizer prices, and, at the same time, lessen environmental concerns relating to nitrate pollution. The objective of this experiment was to evaluate the influence of N fertilizer placement and row configuration on corn yield on a Mississippi River alluvial soil.

Procedures

A field experiment was conducted in 2007 on Sharkey silty clay at the Northeast Research Station near St. Joseph, LA evaluating the placement of N fertilizer for both single and twin-row corn produced on 40-inch wide beds. Treatments consisted of two row configuration's, single and twin row, two N fertilizer knife placements, single and dual band, and two N rates, 150 and 240 lb/acre. Nitrogen as 32%-N solution was injected approximately 2-inches deep at the two to three leaf growth stage using either single or dual knives. Plots were four-beds wide and 35 ft long. For single knife placement, N fertilizer was injected on the outside edge of beds one and four and on the inside edge of beds two and three. Croplan Genetics 818 was planted on April 10 at approximately 30,000 seed/acre. Single rows were planted with a John Deere 1700 and twin rows were planted with a Monosem twin-row planter at a spacing of 9.5 inches. The trial was furrow-irrigated whenever the soil moisture deficit reached 1.5-inches, which was based on the University of Arkansas's Irrigation model. Cultural practices as recommended by the LSU AgCenter were followed.

The experimental design was a randomized complete block with a split plot arrangement of treatments having four replications. Row configuration was the main plot and knife placement and N rate were factorially arranged as split plots. Corn was hand harvested on bed two of the four-row plots, including both rows for the twin-row configuration. Knife placement and description of row positions are illustrated in Fig. 1. A shelling percent was determined and corn yield was converted to shelled corn at 15.5% moisture. Grain yield components, ears/acre, kernel weight, and kernels/ear, were also determined. Total kernel-N uptake was determined. Kernel N was determined by the LSU AgCenter's Soil & Plant Analysis Laboratory. Kernel-N uptake was calculated on a dry weight basis by multiplying the kernel-N concentration by yield. Data was analyzed using the GLM procedure of SAS. The LSD (0.10) was used to evaluate treatment differences when the F-test indicated significance ($P \leq 0.10$).

Results and Discussion

Rainfall for April through June was below the long-term average, with rainfall for the critical month of June only 0.53 inches. There were seven furrow-irrigations beginning on May 16 and terminating on July 2. Rainfall in July was excessive, totaling over 16 inches. Corn in this trial was planted relatively late (April 10) and did not silk out until about June 8.

For the dual knife placement, yields were similar between single and twin rows (Table 2). Single-knife placement increased yield 9.6% greater than dual-knife placement for single row, while dual-knife placement increased yield 4.9% greater than single-knife placement for the twin-row system. Averaged across knife placement and N rate, yields for the single and twin rows were 175.9 and 166.4 bu/acre, respectively. The influence of knife placement on yield was similar for both N rates (Fig. 2). Kernel-N uptake followed the same trend as yield, except at the higher N rate on the twin row, where kernel-N uptake was similar for both fertilizer placements (Fig. 3). For single row, knife placement was approximately 8 inches from row for single knife and approximately 12 inches on each side of row for dual placement.

The relationship between row position and fertilizer placement on yield for the twin row is shown in Table 3 and Figs. 4-5. For the single band, the row closest to the fertilizer band (row position-two) produced 42% higher yield than the companion row (row position-one) (Table 3 and Fig. 4). Row position-2 for single knife placement produced the highest yield of any row position/knife placement. However, this increase in yield for row position-2 was not able to offset the much lower yields for position-1, resulting in overall yields being less for the single versus dual-knife placement. There were no differences in yield between paired rows when N fertilizer was applied with dual knives. Yield responses due to row positions were similar across N rates (data not shown). Knife placement for the dual placement was 6 to 8 inches from rows on each side of the bed.

Plants on row position-1 (row opposite fertilizer injection) were shorter, spindlier, and chlorotic compared to plants on row position-2, suggesting a lack of N. Measurements including plant height, SPAD readings, and stalk diameter confirmed these observations (data not shown). There were fewer ears harvested for the single-knife placement on row position-1, which was probably caused by barren plants, not fewer plants. Kernel-N uptake was much higher for row position-2 for the single knife placement; however, there were no differences in kernel-N uptake for the 240 lb N/acre rate (Fig. 3). It appeared that plants opposite the fertilizer band could not compete with plants adjacent to fertilizer band, probably due to insufficient N.

Table 1. Rainfall received at St. Joseph, 2007

Month	Rainfall Inches
March	1.30
April	3.33
May	1.80
June	0.53
July	16.03
August	3.55

Table 2. Influence of row configuration, knife placement, and N rate on grain yield and yield components on Sharkey silty clay at St. Joseph, 2007.

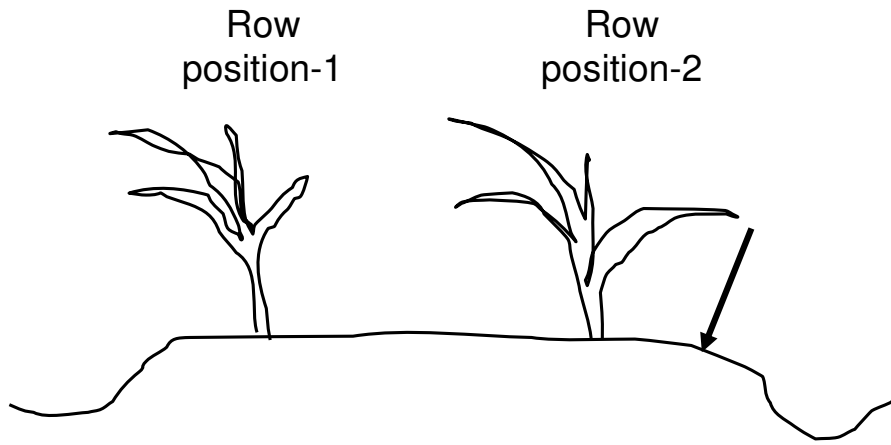
Row Configuration	Knife placement	Yield bu/acre	Ears no/acre	Kernel weight g/100	Kernels no/ear
Single	Single	184.7	31,290	30.1	506
	Dual	167.0	30,160	29.2	482
Twin	Single	162.3	27,920	29.9	490
	Dual	170.5	29,370	29.4	508
LSD (0.10)		8.9	NS	NS	24

Table 3. Influence of row position, knife placement, and N rate on grain yield and yield components on Sharkey silty clay at St. Joseph, 2007.

Knife placement	Row position ¹	Yield bu/acre	Ears no/acre	Kernel weight g/100	Kernels no/ear
Single	One	59.7	26,660	28.5	380
	Two	102.6	29,570	30.8	570
Dual	One	82.1	29,960	29.4	492
	Two	88.4	28,780	29.2	524
LSD (0.10)		10.1	2,810	1.0	27

¹RP-one is row on opposite side of bed from fertilizer placement.
 RP-two is row adjacent to fertilizer placement.

Single Knife Placement



Dual Knife Placement

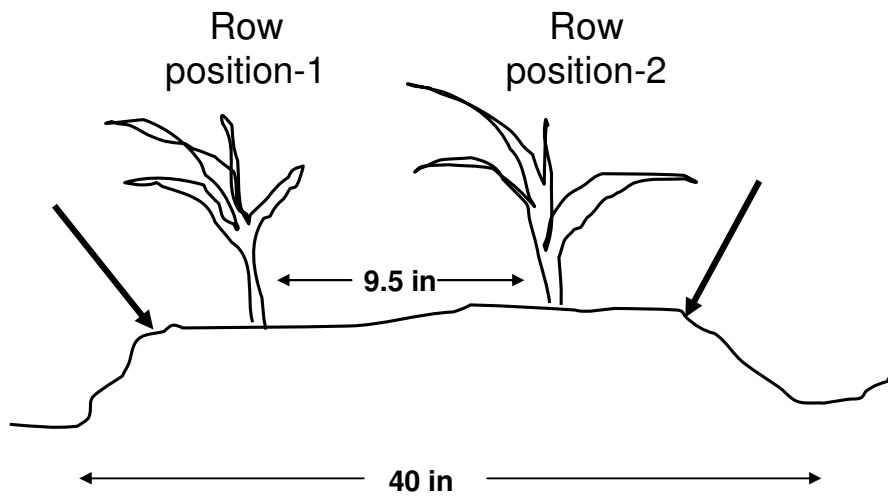


Fig. 1. Single knife placement for bed two is depicted in the upper illustration and dual knife placement in lower illustration.

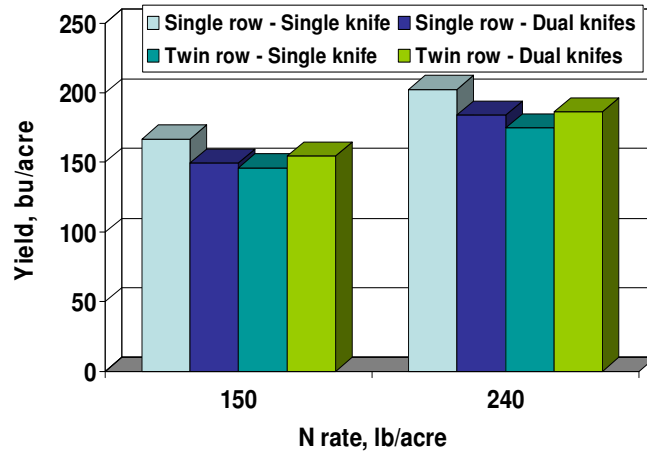


Fig. 2. Influence of row configuration, N fertilizer knife placement, and N rate on corn yield on Sharkey silty clay at St. Joseph, 2007.

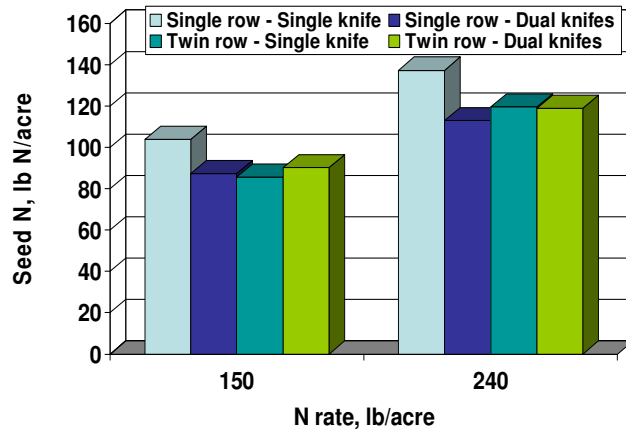


Fig. 3. Influence of row configuration, N knife placement, and N rate on corn kernel-N uptake on Sharkey silty clay at St. Joseph, 2007.

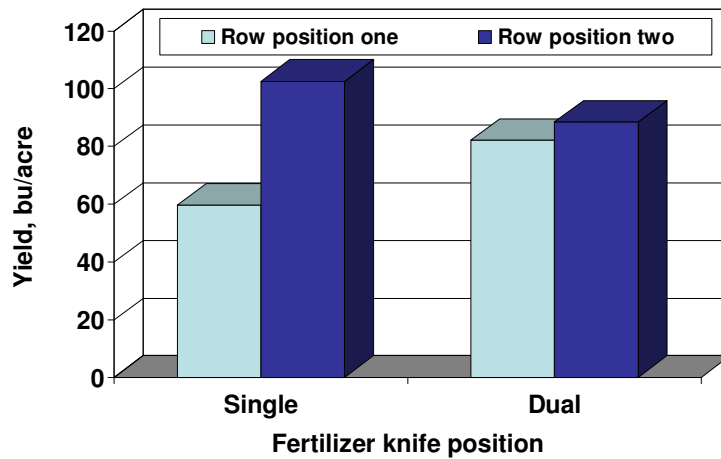


Fig. 4. Influence of N fertilizer knife placement on corn yield on each row position on twin rows on Sharkey silty clay at St. Joseph, 2007.

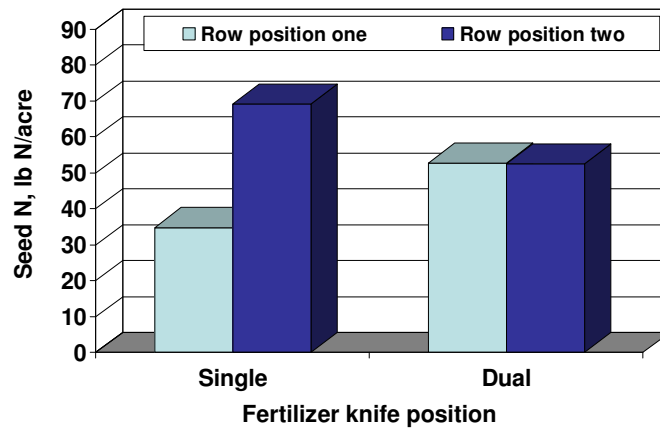


Fig. 5. Influence of N fertilizer placement on corn kernel-N uptake on each row position on twin rows on Sharkey silty clay at St. Joseph, 2007.