# Integrating Soil Nitrate to Refine Nitrogen Fertilizer Recommendation in Louisiana Corn Production Systems

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## BACKGROUND

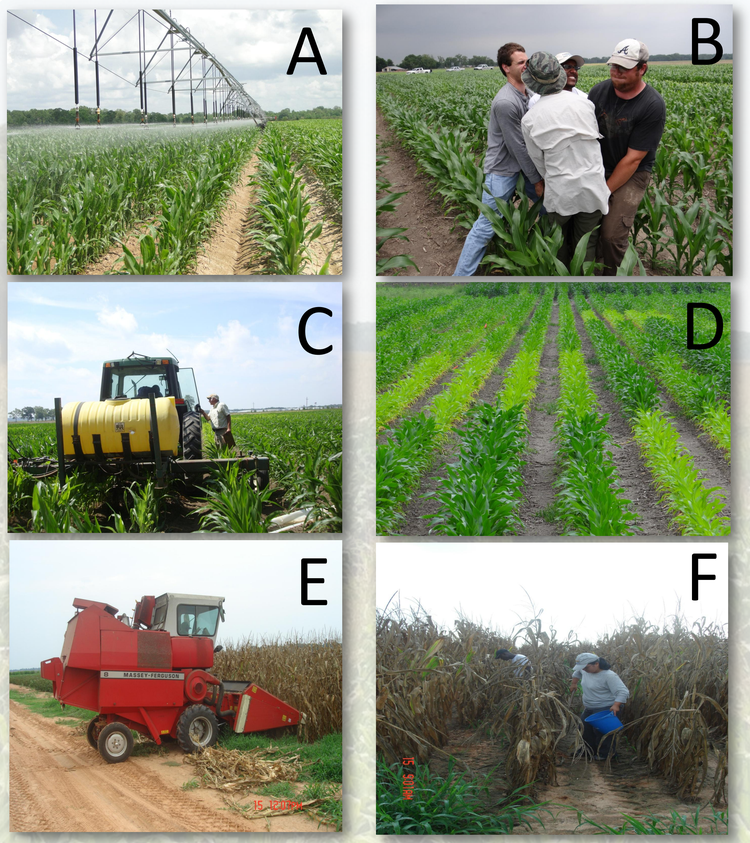
- Corn (*Zea mays L.*) acreage in Louisiana has increased from less than 200,000 hectares to almost 300,000 hectares due to price increases and technological breakthroughs in genetics that allow farmers to plant in areas where soil conditions were believed to be to harsh for corn crops.
- Nitrogen requirement of corn is large and in Louisiana current recommendation ranges from 180 to 269 kg ha$^{-1}$; this was established based on the average optimal N rate from multiple years and sites N response trials.
- Improving N management in crop production continues to occupy the largest effort invested in the realm of soil fertility and nutrient management research.
- Projection of corn N requirement can be based on expected yield goal and its further refine using soil nitrate level.

## OBJECTIVES

- Establish preplant N rate requirement of corn based on soil nitrate level.
- Document impact of split N rate application at preplant and midseason V8 leaf stage.

## RESEARCH APPROACH

- An N trial was established at two sites in Northeast, LA: St. Joseph (Sharkey clay – very-fine, smectitic, thermic Chromic Epiaquerts) and Winnsboro (Gigger silt loam - fine-silty, mixed, active, thermic Typic Fragiudalfs).
- The experimental design was a randomized complete block with four replications. Plot sizes were 4 rows, 13 m long with a row spacing of 102 cm.
- Seven treatments were deployed to test the yield effects of preplant N rate in 67 kg N ha$^{-1}$ increment starting at 0 and extending to 402 kg N ha$^{-1}$. Four treatments were deployed to test the split application of N at preplant and midseason (V8 leaf stage – 8$^{th}$ collared leaf is visible).
- Establishment: Seeds of corn variety Pioneer 2088HYR (St. Joseph) and Pioneer 1319HR (Winnsboro) were planted at a population of 80,000 ha$^{-1}$.
- Irrigation system: St. Joseph – polypropylene pipe irritation system; Winnsboro – overhead sprinkle system
- Soil sampling was done preplant and at harvest at two depths, 0-15 cm and 15-30 cm, extracted with 1M KCl and analyzed for $NO_3$ content using Lachat QuikChem 8500 Flow Injection Analysis System.
- Plots were harvested using a combine harvester.
- Statistical analysis: Analysis of variance to determine significance of treatment effect.




**A– Overhead sprinkler system in Winnsboro. B- Soil sampling in St. Joseph. C- Knifing-in liquid N fertilizer (UAN) at St. Joseph. D- Visual corn N responses in St. Joseph. E- Plot combine harvester. F- Soil sampling.**

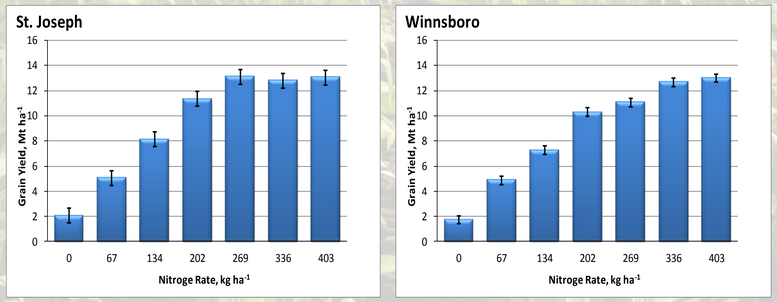



**Figure 1.** Corn grain yield response to preplant nitrogen at St. Joseph and Winnsboro sites, 2013.

**Table 1.** Grain yield and net return of corn with delayed and split applications of N fertilizer. *Preplant N rate of 269 kg ha$^{-1}$ was referenced for computation of net return; Grain price - $290 Mt$^{-1}$.

| N Rate, kg ha$^{-1}$ | | Grain Yield, MT ha$^{-1}$ | | Net Return, $ ha$^{-1}$ | |
|---|---|---|---|---|---|
| Preplant | Midseason | St. Joseph | Winnsboro | St. Joseph | Winnsboro |
| *269 | 0 | 13.11 | 11.06 | - | - |
| 0 | 269 | 9.69 | 10.05 | -990 | -292 |
| 67 | 202 | 11.70 | 11.38 | -408 | 93 |
| 134 | 134 | 12.78 | 13.25 | -95 | 636 |
| 202 | 67 | 12.05 | 12.17 | -316 | 322 |

## RESULTS AND HIGHLIGHTS

- The current N recommendation for corn in Louisiana ranges from 180 to 269 kg ha$^{-1}$. The high end of recommendation is for irrigated corn cultivated on alluvial soils while the low end is for corn on upland soil, non-irrigated production system. Results of this years' N response study showed that the highest significant grain yield was obtained from plots which received 269 and 336 kg N ha$^{-1}$ for St. Joseph and Winnsboro , respectively (Fig. 1).
- Grain yield of plots which received one-time application of 269 kg N ha$^{-1}$ at planting was compared with grain yield of plots that received the same N rate but at different two-split proportions (Table 1). In St. Joseph, split-N applications resulted in reduced grain yield and large losses in net return, the largest was $990 without preplant N. Similarly, Winnsboro site had lost return without preplant N but benefited with splitting N in different proportions. Equal splits of 134 kg N ha$^{-1}$ obtained the highest grain yield and increased net return by $636 ha$^{-1}$ when compared to one-time application of N at preplant.
- The differential response of corn to N application scheme between these two sites is expected because of the influence of soil type on productivity and soil $NO_3$ level. The Sharkey clay soil at St. Joseph site, inherently, has high yielding potential compared with the moisture-limited, low-organic matter containing Gigger silt loam. High yield level translates to high N demand. The high water holding capacity of Sharkey clay leads to higher losses of N by denitrification in soil microsites than Gigger silt loam. In addition, $NO_3$ losses can be substantial through leaching of water through cracking clay soils.
- In previous years, corn planted on Sharkey clay soil required higher preplant N (at least 134 kg N ha$^{-1}$) and total N rates (302 kg N ha$^{-1}$) than on Gigger silt loam soil to maximize grain yield. This was partly explained by soil $NO_3$ level; early season levels of soil $NO_3$ within the 0-30 cm on Sharkey clay (≈ 10 kg $NO_3^-$ ha$^{-1}$) were found to be consistently lower than Gigger silt loam (≈ 35 kg $NO_3$ ha$^{-1}$). This year, soil $NO_3$ at planting on Gigger silt loam averaged only 18 kg $NO_3$-N ha$^{-1}$ resulting in higher preplant N requirement than previous years (67 vs 134 kg N ha$^{-1}$); this when combined with 134 kg N ha$^{-1}$ application at V8 leaf stage had maximized grain yield (*P*<0.001).
- Given that corn production areas in Louisiana consist of highly diverse soils, effective N decision tools would require a combination of different management practices including the use of soil $NO_3$ testing.

## ACKNOWLEDGEMENT

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