ARKANSAS CORN AND GRAIN SORGHUM PROMOTION BOARD

OPTIMIZING FERTILITY REQUIREMENTS OF CORN

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INTRODUCTION

Corn was produced on approximately 90,000 acres annually in the early 90's. In the 2002-2003 seasons, corn was planted on nearly 300,000 acres. Since then, acreage has been around 500,000 acres. The considerable increase in crop acreage requires the validation and, if needed, the modification of existing N-fertilizer recommendations for corn grown in heavy-textured soils, as a significant percentage may be grown under such conditions. Nitrogen recommendations for heavy soils result on costs as high as $120 - 130 per acre in nitrogen fertilizer alone. The objective of this study is to validate existing N fertilizer recommendations for corn grown in heavy-textured soils and maximize fertilizer use efficiency.

PROCEDURES

Research plots were established at the Northeast Research and Extension Center (NEREC, Sharkey-Steele complex) at Keiser, and at the Southeast Research and Extension Center (SEREC, Hebert) at Rohwer for three years, beginning in 2007. Soil samples were collected from the 0- to 6- and 6- to 12-inch depths prior to planting and were extracted using the Mehlich 3 procedure. Nitrate N was analyzed with an ion selective electrode, and pH was measured in a 1:2 soil:water (wt:vol) mixture. Treatments consisted of N rates equivalent to 0, 50, 100, 150, 200, 250, 300, and 350 lb N/acre Ammonium nitrate was used to minimize volatilization losses. The intended plant population was 31,000 plants under irrigated conditions. Corn hybrids Pioneer 33M57, Dekalb DKC 64-78, and Terral 26BR41 were used during the 2007 and 2008 seasons, and only the Pioneer and Dekalb hybrids for the 2009 season. Each plot contained four 38-inch wide and 25-ft long rows with treatments arranged in a randomized complete block design and replicated five times. Nitrogen rates were applied in a 2-way split as ammonium nitrate, with 50% of the total-N rate applied at emergence and the remaining N applied before the V6 stage, for treatments 0, 50, 100, and 150 lb N/acre. For treatments 200, 250, 300, and 350 lb N per acre, nitrogen was applied as described before, but included an additional application equivalent to 45 lb N per acre before tassel emergence.

Phosphorus and potassium were applied according to soil-test recommendations, while irrigation and weed and insect control were performed according to Cooperative Extension Service recommendations. At each location, the two middle rows were

harvested with a plot combine equipped with a weigh-system and grain moisture meter. Yields were adjusted to 15.5% moisture content for statistical analysis. The least significance procedure of SAS was used to test for differences among mean treatment yields. Relative yields were plotted against N rate and an exponential model was fitted. An optimal N rate was estimated as the N rate where 95% relative yield intercepted the regression line.

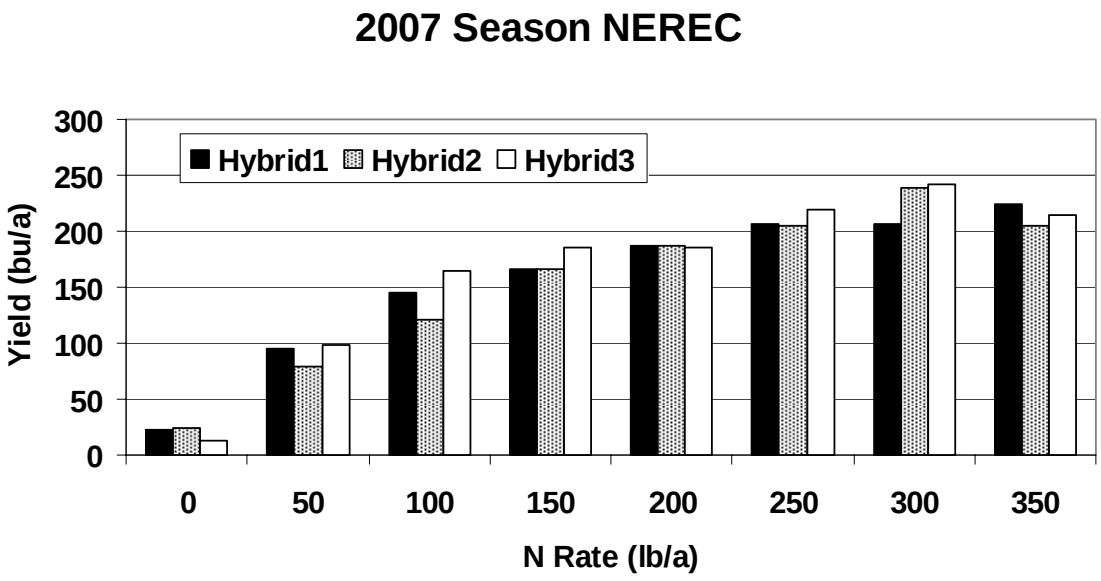

Fig 1. Yield response of 3 hybrids to varying N rates during 2007 at NEREC

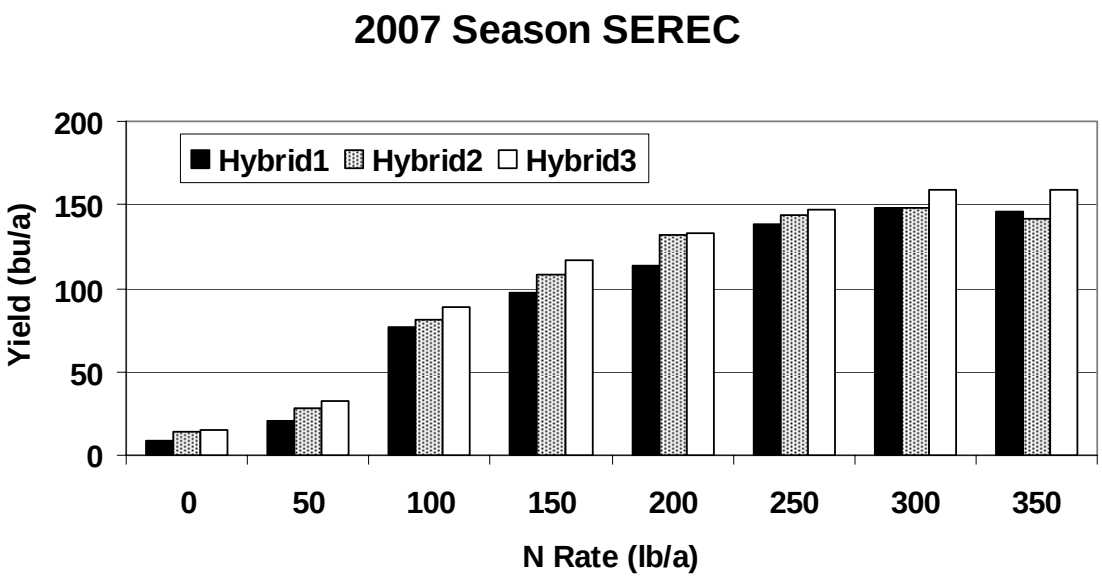

Fig 2. Yield response of 3 hybrids to varying N rates during 2007 at SEREC.

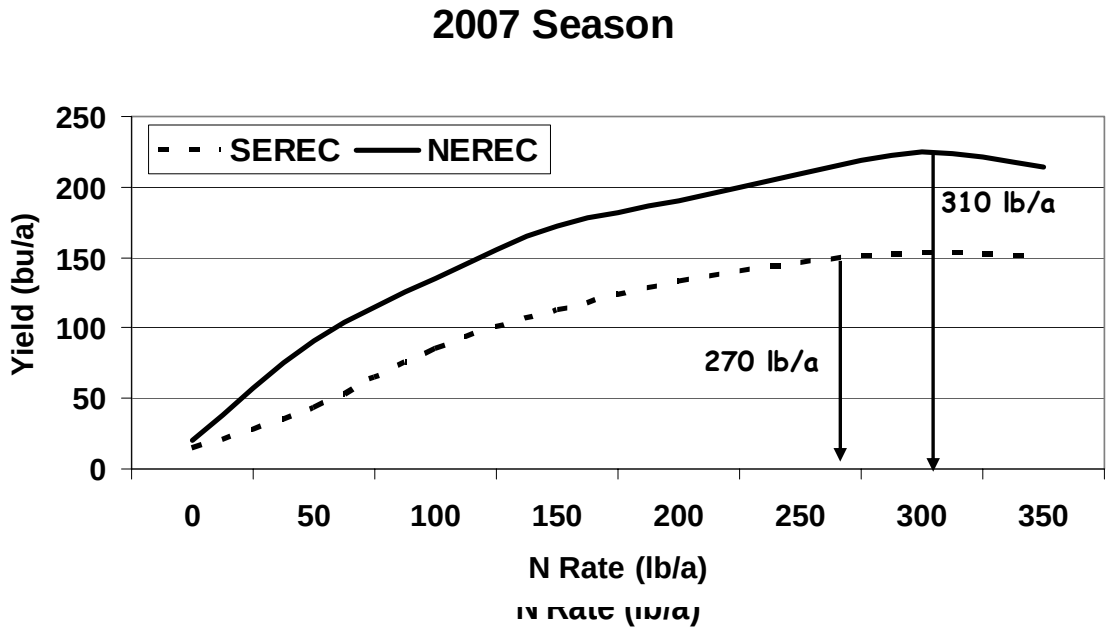

Fig 3. Difference in optimum N rate between SEREC and NEREC during 2007.

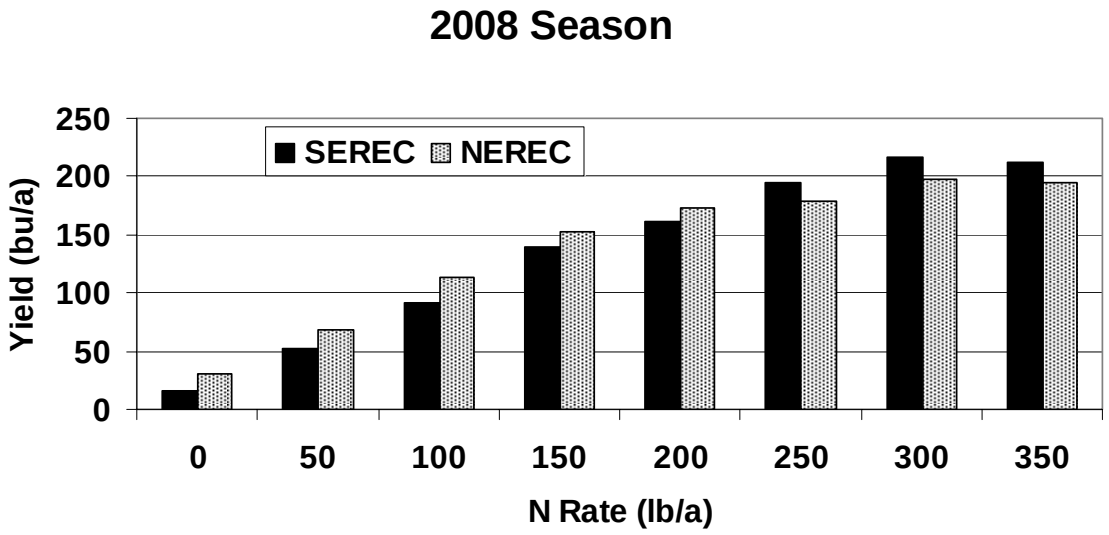

Fig 4. Average yield response during the 2008 season

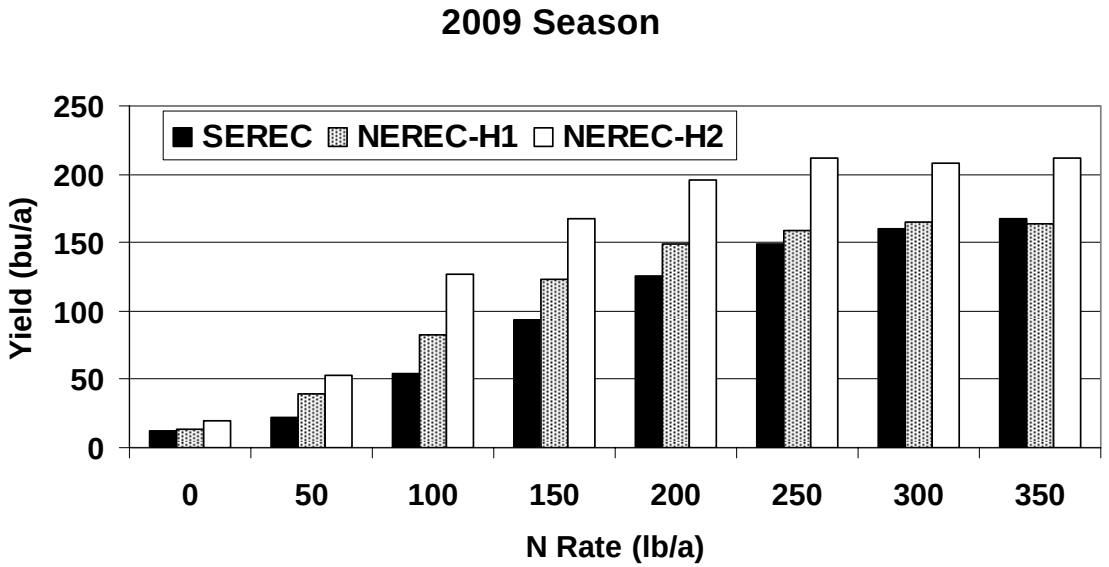

Fig 5. Average yield response of 2 hybrids at NEREC and SEREC

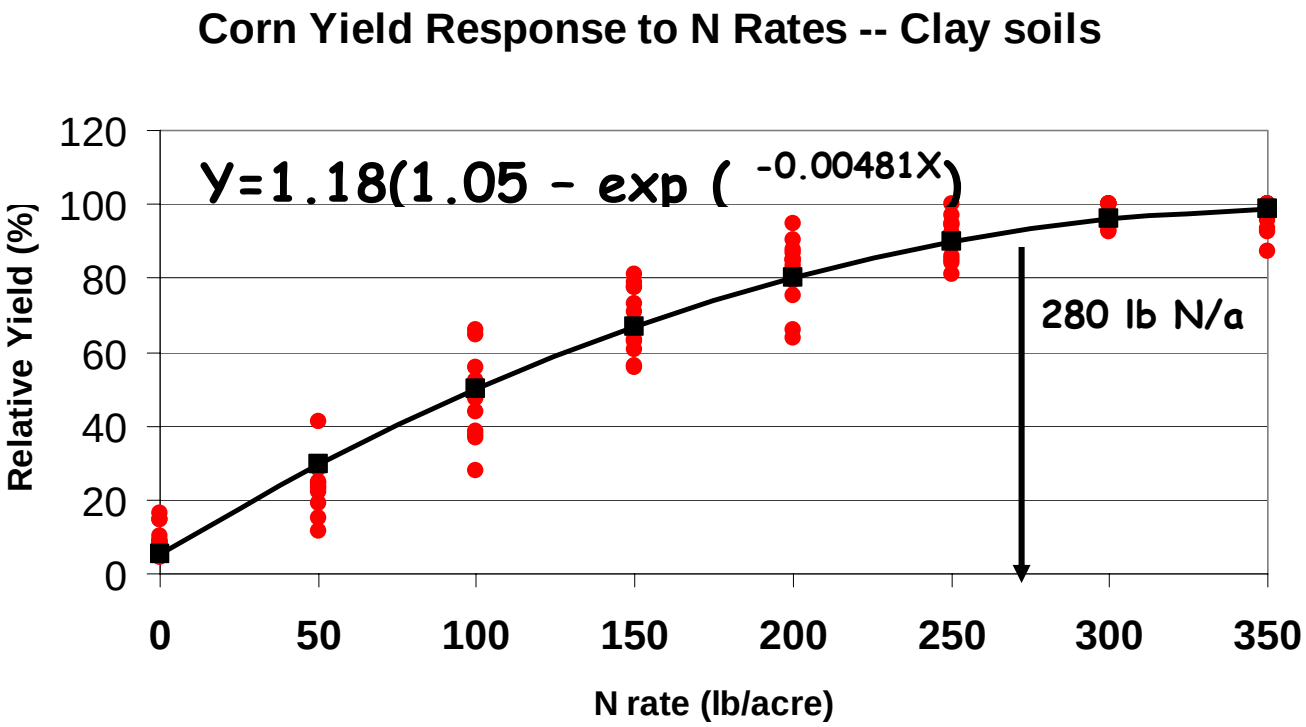

Fig 6. Relative yield response across years, hybrids and locations

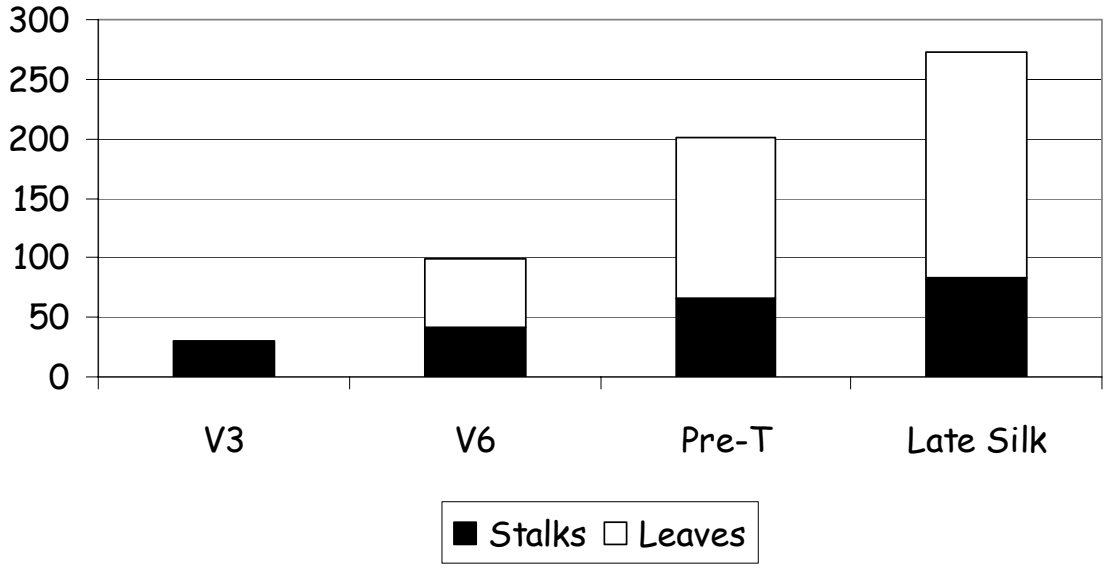

Fig7. Nitrogen uptake pattern (lb/a) of corn according to growth stage.

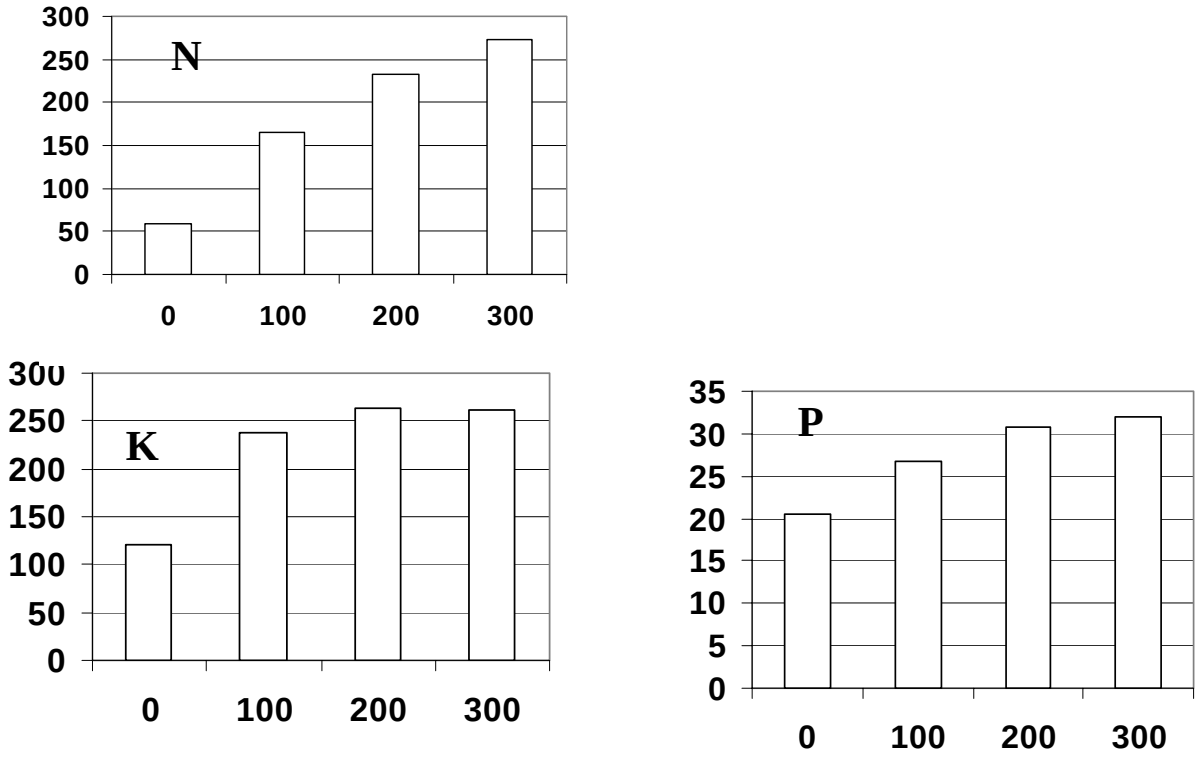

Fig 8. Uptake pattern of N, P, and K according to N rate treatment.

Figures 1 and 2 show the yield response of the 3 hybrids selected at NRREC and SEREC during 2007. There is an obvious linear response trend till 250-300 lb. During this year there was not a significant difference among hybrids, however, there was a significant difference among locations. Figure 3, shows the yield response at both, NEREC and SEREC, with the rate at which 95% relative yield was obtained. At NEREC, yields were maximized with 310 lb/acre, while at SEREC yields were maximized at 270 lb/a. Although there is a 40 lb/a difference in nitrogen rate, the difference in yields was larger. At NEREC, highest yield obtained was 225 bu/acre, compared to 153 bu/acre at SEREC. The low yields observed at SEREC were probably a result of intensive rain (4 inches) soon after fertilizer application.

Yield differences between NEREC and SEREC during 2008 were not as marked as during 2007. At SEREC, the highest yield observed was 212 bu/acre, compared to 198 bu/acre at NEREC.

During the 2009 season, two locations were selected at NEREC, one had soybeans the previous year, while the other location had cotton during 2008. Yield variability was larger between hybrids that between crop rotations. Figure 5 shows a significant larger

yield response of Hybrid 2 when compared to hybrid 1 at NEREC. However, yields for both hybrids were maximized at 250 lb N/a. Yields at SEREC were maximized at 300 lb N/a.

After three years, we observed significant differences among hybrids and locations for some years only. Such differences were not consistent during each season. All the yields for all locations and years were pooled together, and a regression model was fitted. Figure 6 shows relative yields and N rates. Yields were maximized (95% relative yield) at 280 lb N/a.

Figure 7 and 8 show nutrient uptake patterns for one of the hybrids during 2009. A corn plant does not use significant amounts of nitrogen in the first 35 days, with demand increasing significantly after V6. This is one of the reasons why U of A recommendations call for sidedress applications to be conducted at V6 or soon after this growth stage. Figure 8 shows uptake patterns for N, P, and K according to N rate. It appears that a corn plant will use significant amounts of potassium even under nitrogen deficient conditions. The information provided in this graph should be considered when calculating the value of corn stubble as feedstuff or the potential for corn to be grown for biofuel purposes.

CONCLUSIONS

Current nitrogen recommendations for corn grown in clay soils call for rates as high as 330 lb N/acre. This recommendation is based in existing data that did not include the use of a pre-tassel application. The information generated in this study shows the potential to reduce nitrogen applications without detrimental yield effects. However, the fact that there were differences among hybrids and locations required further evaluation to further fine tune existing recommendations.