ALABAMA COOPERATIVE Extension SYSTEM
Alabama A&M and Auburn Universities

AGRONOMY AND SOILS SERIES

TIMELY INFORMATION

Agriculture & Natural Resources

April 2011

Do Nitrogen Fertilizer Rate and Application Timing Make a Difference in Corn Production?

The high prices of nitrogen fertilizer have forced corn producers to consider strategies to increase nitrogen use efficiency. Improving nitrogen management in corn could involve the implementation of several management strategies. Side dressing, adjustment of nitrogen levels according to the site's yield potential, and soil water availability on nitrogen uptake are important considerations before deciding the in-season nitrogen strategy. Results from a two-year study on nitrogen application for corn conducted at two different locations in Alabama are presented here. Although two years of data are not sufficient to determine the best nitrogen management strategy by location, the data provide baseline information on factors that might influence corn response to nitrogen application.

Description of the Experimental Study

A corn nitrogen fertilization study was conducted at the Tennessee Valley Research and Extension Center (TVREC) in Belle Mina, AL and the E. V. Smith (EVS) Research Center in Shorter, AL during 2009 and 2010. The main goal of each study was to evaluate the impact of nitrogen fertilizer rates and timing on grain yield of two corn hybrids under irrigated conditions. The experiment consisted of 16 different treatments where the nitrogen was applied in three different ways: a) all nitrogen applied at pre-plant, b) half of total nitrogen applied pre-plant and the other half in a side-dress application at the V6 growth stage, c) 1/3 of total nitrogen applied pre-plant and the remainder in a side-dress application at the V6 growth stage. The corn hybrids planted were Pioneer 31P42 and Dekalb 67-87. Experimental plots were 4 rows wide by 30 ft long. Treatments were replicated four times in a randomized complete block design. Yield data was recorded after harvesting the middle two rows of each plot. Because there were not yield differences between hybrids respect to the nitrogen treatments, average yield data for both hybrids is presented here.

Results

Yield differences between nitrogen rates

Both growing seasons differed in yield and in the amount of rainfall the crop received during the critical periods of the growth cycle for grain production (e.g., tasseling and grain filling). Overall, yield was higher in 2009 than in 2010, independent of the location. In 2009, corn responses to high nitrogen rates resulted in higher yield than in 2010 (Figures 1 and 2).

When yield data was averaged over total nitrogen applied (hatched bars on the graphs), independent of the split (e.g., 0, 50, 100, 150, 200, 250 lb N/acre), there were not yield increases above 150 lb N/acre at the EVS location (Figure 1). For both years, the yield reached a plateau at relatively high levels of nitrogen and, in some cases, yield decreased as rate increased (Figure 1). A different situation was observed at the TVREC location in 2009 and 2010 with yield increasing as nitrogen rate increased (Figure 2).

Is side-dressing a portion of nitrogen in-season a better nitrogen strategy than applying all N at planting?

Across locations and years, the split application of nitrogen resulted in higher yield than total nitrogen applied at planting. In most cases, a trend for higher yield was observed when 70% of the total nitrogen was applied at V6 rather than a side-dress application of 50% of the total nitrogen. Therefore, the split application of 30% of total nitrogen supplied pre-plant and the other 70% supplied at the V6 growth stage resulted in higher yields especially when high nitrogen rates were applied (Figures 1 and 2). In contrast, for low nitrogen application rates, 50 lb N/acre, the best strategy was to side-dress most of it. When the 30/70 split application (e.g., treatments 30-70, 50-100, 60-140, and 80-170 lb N/acre) was compared with total nitrogen applied at planting (e.g., 100-0, 150-0, 200-0, 250-0 lb N/acre), a higher response to the split application was observed at most locations. In 2009 at the EVS location, where the predominant soils are loamy sands, yield increases of 33% were observed with the 30/70 split N application. During the same year and treatment comparisons, yield increases of 6% were observed at the TVREC location, which consists of silt clay loam soils. In 2010, yield increases of 7% and 9% were observed for the EVS and TVREC locations, respectively.

Yield differences between the 30/70 split application of nitrogen and the 0 control nitrogen rate, were also evaluated. At the EVS location in 2009 and 2010, there were not yield differences between treatments 50-100, 60-140, and 80-170 lb N/acre treatments (Figure 1). At the TVREC location, yield increased as rate increased during 2009 and 2010. However, when the 30/70 split application treatments where compared, yield was similar for the 60-140, and 80-170 lb N/acre treatments in 2010 (Figure 2).

What could cause yield differences between locations and years?

1. In general, higher yields were observed at the TVREC location than the EVS independent of year and hybrid. Therefore, one could conclude that the TVREC location with silty clay loam soils has a higher yield potential than the EVS location with loamy sand soils.
2. In 2009, rainfall was above the historic average for the months of May, August and September at EVS (Figures 3a and 3b). At TVREC, rainfall was above the historic average for the months of May, July, August and September. Therefore, climatic conditions during the 2009 growing season, influenced by El Niño phase, favored corn growth and development resulting in higher yields compared to 2010. Even though both sites were under irrigation, abundant rainfall allowed continuous soil water availability to the corn plants.
3. In 2010, rainfall was below the historic average for the months of March, April, June and September at the EVS location (Figure 3a). At TVREC, monthly rainfall was below the historic average during all the growing season except for the month of May (Figure 5b). Even though irrigation applied to the crop mainly from May to June could have supplemented the lack of rainfall (Figures 3a and 3b), timing of either rainfall or irrigation may have had an impact on growth and yield.

4. Average maximum temperature could have contributed to yield differences between years. In 2010, this parameter increased especially during the months of July, August and September at the TVREC location and during most of the growing season at EVS (Figures 3c and 3d). The reduction in rainfall and increase in maximum ambient temperature during 2010 were the result of the influence of La Niña phase on the climatic conditions in the Southeast. Low rainfall combined with increased ambient temperatures in 2010 could cause the yield reductions observed at both locations.
5. Corn produced on silty clay loam soil texture at TVREC, seemed more responsive to increasing nitrogen levels, especially when monthly rainfall was above average (e.g., 2009). In 2009, average yield at TVREC ranged from 168 bu/acre to 208 bu/acre for rates equal or higher than 150 lb N/acre. In contrast, yield at EVS, where loamy sand soil is predominant, ranged from 154 bu/acre to 160 bu/acre for rates equal or higher than 150 lb N/acre.

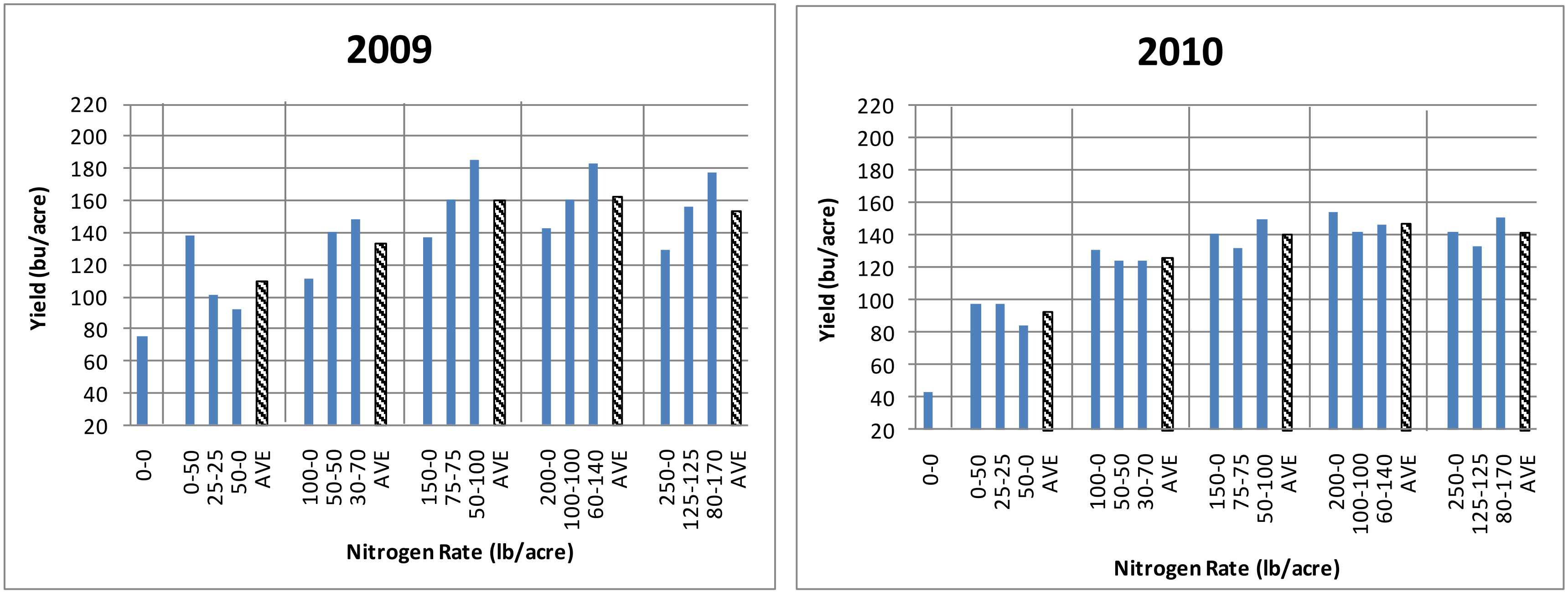

Figure 1. Yield differences for various split applications of nitrogen treatments. E. V. Smith 2009 and 2010. Note: The x-axis corresponds to the different nitrogen treatments evaluated. The first number of each nitrogen rate combination indicates the amount of nitrogen applied at pre-plant and the second number corresponds to the side-dress rate. The hatched bars correspond to the average yield of the three different nitrogen treatments for each nitrogen level.

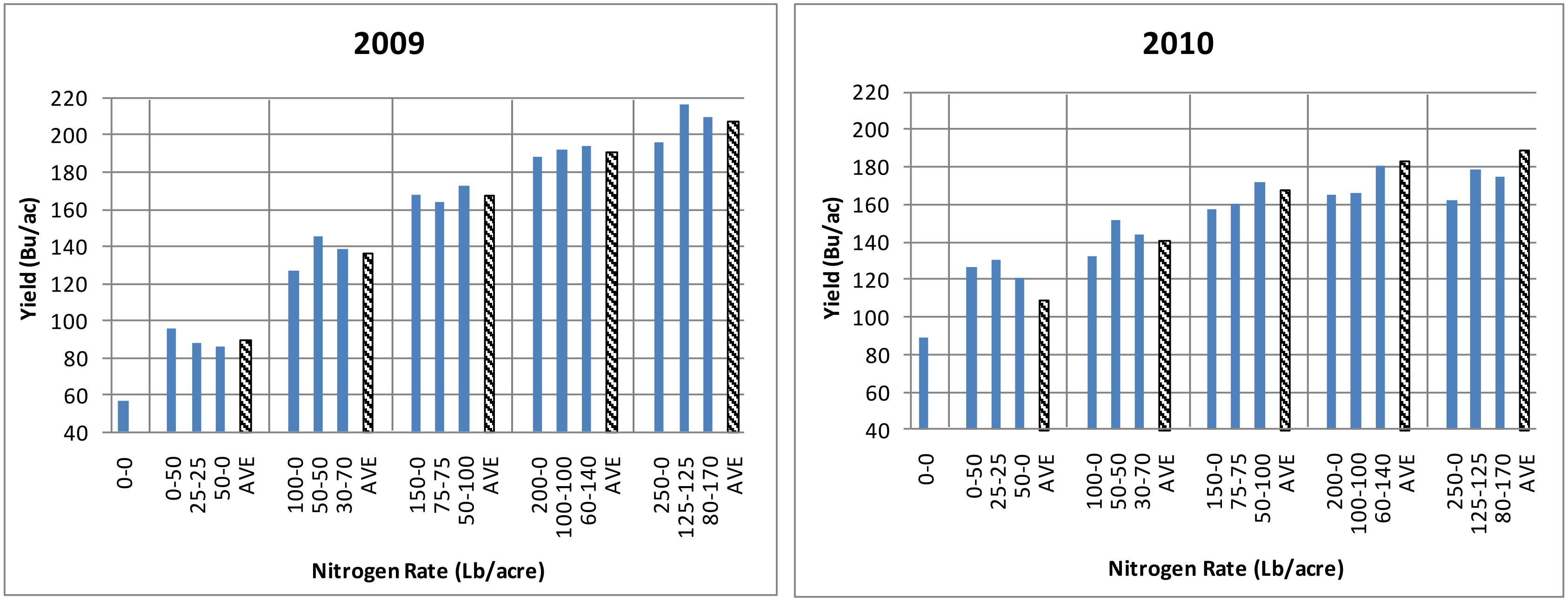

Figure 2. Yield differences for various split applications of nitrogen treatments. Tennessee Valley 2009 and 2010. Note: The x-axis corresponds to the different nitrogen treatments evaluated. The first number of each nitrogen rate combination indicates the amount of nitrogen applied at pre-plant and the second number corresponds to the side-dress rate. The hatched bars correspond to the average yield of the three different nitrogen treatments for each nitrogen level.

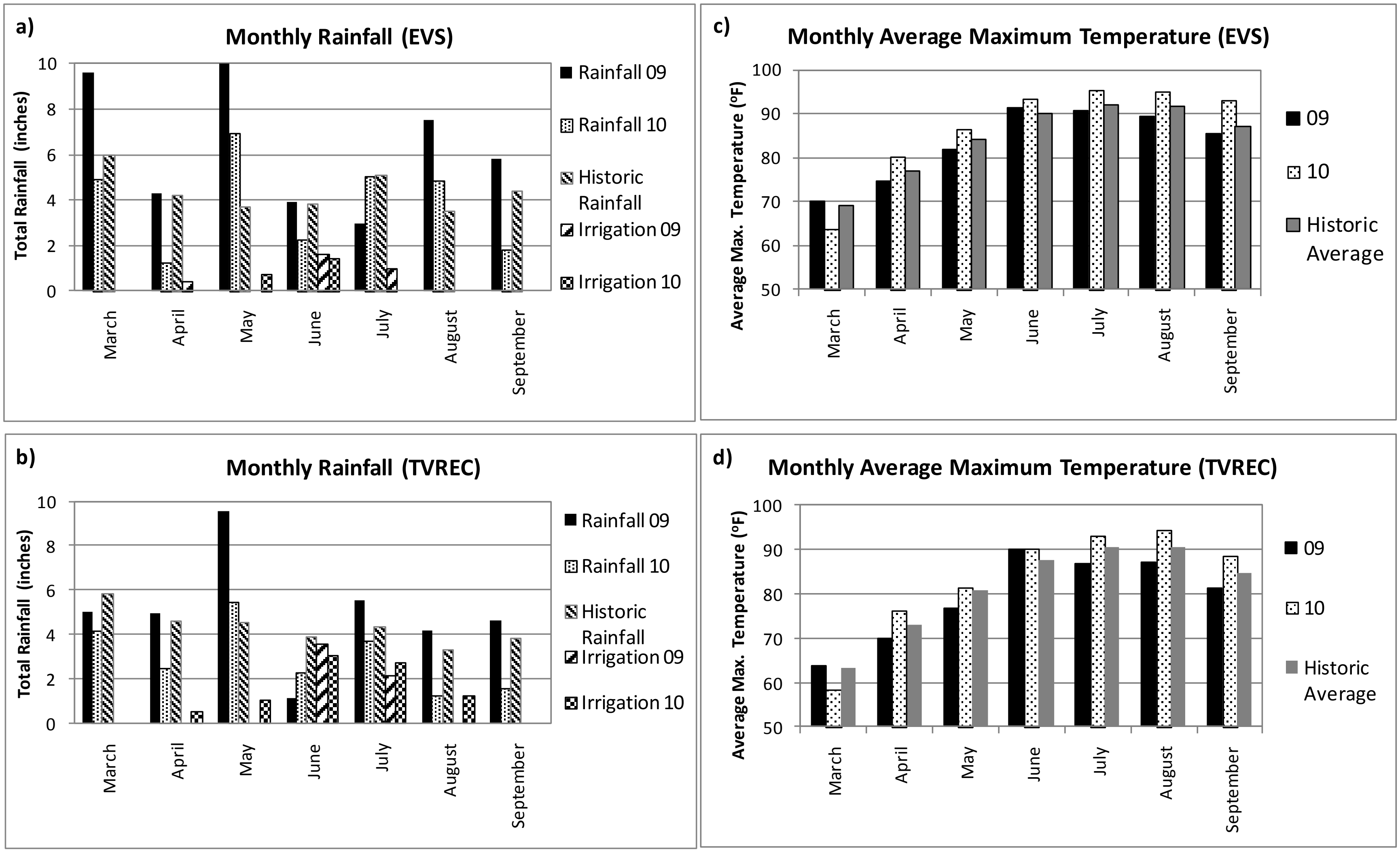

Figure 3. Monthly distribution of total rainfall and average maximum temperature for the EVS and TVREC locations in 2009 and 2010.

Prepared by

Brenda V. Ortiz, *Assistant Professor and Extension Specialist*, Charles Burmester, *Extension Agronomist*, and Kip Balkcom, *Research Agronomist*, USDA-ARS.