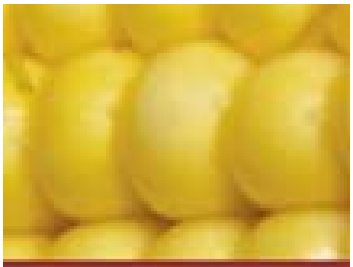
Mississippi Corn Promotion Board
2013 Progress Report

Project Title: Defining Mid-Season Nitrogen Management (Tassel) for Optimum Corn Production

PI: Dr. M. Wayne Ebelhar

Department: MSU/MAFES, Delta Research and Extension



Project Summary (Issue/Response)

Many cultural practices are important for optimum corn production in Mississippi. Plant population (seeding rates), nitrogen (N) fertilization, and irrigation are key components for optimum corn production in the Mississippi Delta. Corn production for the state reached 940,000 acres in 2007 and was expected to reach one million in 2013. However, early season weather issues led to a shift to other crops. Production has not topped a million acre since 1960 at which time the yield was 27 bu/acre. Earlier planting has surfaced as a means of increasing yields in soybean and has become the norm in corn production with even earlier planting as weather permits. Increased seeding rates and N rates have been evaluated in the Mid-south as means of increasing corn yields. Nitrogen management issues continue to be addressed and include N rates and timing of application across many scenarios including late season N applications (pre-tassel). The current series of studies have been designed to evaluate levels of pre-tassel N (PTN) applied across multiple standard N applications and also take the practices to producer fields. The objectives are to 1) evaluate N management systems for optimum production that incorporates a range of standard N rates along with pre-tassel N (expanded to other soils , and 2) investigate the economic implications of pre-tassel N management compared to the standard N management system. In 2013, PTN applications were included in cultivar by N management studies in producer fields. Also, preliminary studies were initiated in an attempt to better define the PTN timing. As N prices continue to rise, efficient use of fertilizer N is paramount to optimum N utilization. Getting N to that plant at a time when it can be best utilized is key to efficient use. Better plant utilization also means less N subjected to loss through various means including nitrification/denitrification, volatilization, run-off, possible leaching on sandy soils, and uptake by non-target species (weeds). Enhanced utilization by target species leads to less release to the environment and overall better stewardship of input resources. Preliminary research has shown significant response to pre-tassel N with the greatest response at lower N rates.

Project Results/Outcomes

The 2013 growing season saw an expanded investigation of N management with specific emphasis on evaluating and defining pre-tassel N (PTN). Initial studies begun in 2009 have shown a significant yield increase from supplemental N applications made as late as tassel emergence and pollen development. The response has been greatest where less N was applied early in the growing season as might be expected. With higher N rates, the advantages to PTN have not been as evident. In most years, the 20 lb N/acre rate has been sufficient with little gain from the application of 40 or 60 lb N/acre as urea. However, aerial applicators are reluctant to apply less than 100 lb material/acre. Currently recommended fertilizer N rates are 1.3 lb N/bushel of expected yield. Thus for a 200 bu/acre yield, N fertilizer would be 260 lb N/acre (less behind soybean in rotation, and less potential residual N in the soi). Nitrogen and phosphorus (P) requirements for corn are nearly double that of soybean and cotton while potassium (K) requirements for corn are 40-50% higher than for other crops. Soil testing is a must for determining overall nutrient status and should be the basis for a sound fertility program.

Project Results/Outcomes (continued)

Nitrogen rates and application timing are the most important keys to successful N management. In theory and practice, the closer N application is made to the time the plant needs it, the better the N utilization and N use efficiency. For corn, the principle N uptake form is nitrate (NO_3^-) that is also the form that is most susceptible to biological transformations in the soil. Nitrate-N can come from the mineralization of organic matter or from fertilizer additions. Mineralization releases more N from the soil in years that are favorable for good plant growth. However, early in the growing season the amount to be released through mineralization during the season is unknown. Nitrification and denitrification are biological transformations that occur throughout the year depending upon moisture levels in the soil and temperature. When soils are warm and saturated, corn plants show N deficiency because the N uptake is inhibited. While this can occur throughout the growing season, it is of primary concern during the first half of the growing season before small plants have taken up much N. To aid against denitrification losses several approaches are available. Improved drainage so that water does not stand during the late spring is one approach. Applying N near the time the plants need it is another. Sidedress application of the main N supply is still another approach, while slow release products could be another.

Overall corn grain yields in the state averaged 180 bu/acre (NASS) and exceeded the old state record(165 bu/acre) by 15 bu/acre. For the DREC study on silty clay loam soil, corn yields ranged from just less than 150 bu/acre to highs of more than 250 bu/acre. Based on the standard N rates, grain yields were increased with increasing N rates up to 240 lb N/acre. There was no interaction between standard N rates (SN) and pre-tassel N rate (PTN) , however, there appeared to be a greater response to PTN at the lower SN rates. This has been evident in other years as well. When averaged across SN rates, there was a significant increase in corn grain yield (14 bu/acre) when as little as 20 lb N/acre (as urea) was applied at tasseling. While, there was a slight increase with additional PTN, the increase was not statistically significant. By way of comparison, the addition of 40 lb N/acre produced an increase of 20 bu/acre. Six cultivars were evaluated in producer fields to determine cultivar response to N management that include PTN applications. Actual N rates in the field ranged from 120 to 270 lb N/acre with the corn following soybean in rotation. The six cultivars ranged in maturity from 109 day to 120 days. At the lowest N rate, all cultivars produced at least 220 bu/acre. Most reached optimum yields at 180 to 210 lb N/acre. In only one cultivar, Pioneer 0912HR, was there a significant response to PTN (40 lb N/acre). The lack of response to PTN is thought to be due to the relatively late N applications in general. For this growing season, the first N was not applied until the V5 to V6 growth stage. In theory, the later the N is applied the closer to the time the plant can take it up.

Project Impacts/Benefits

At the outset of the studies with pre-tassel N, little response was expected. Over the last several years, on the silty clay loam soil, there has been a significant response each year. Grain yields have varied with yields of less than 100 bu/acre observed at the lower N rates to yields in excess of 240 bu/acre. The research has shown that later N applications (after V6) can be taken up by plants if moisture is available (rainfall or irrigation). If N losses occur to biological transformations and loss, the deficiencies can be corrected with an aerial application up to tasseling. New work is underway to evaluate the timing of sidedess N and that relationship with PTN applications. The other avenue being explored is an attempt to quantify (using Growing Degree Days) the timing of PTN. Some producers have chosen to apply urea by air as early as V8 to V10 to as late as pollen shed after full tassel development. At present, studies have been designed to address this issue. In 2014, plans are to continue the on-farm investigation across cultivars but to insure early N applications at or before planting. Late N applications, at V5 to V6 does allow for uptake closer to the time that the plants need but can be affected by seasonal rainfall that prevents direct application to the soil. Early applications insure at least some N in place should spring rains limit field operations. Additional information is needed in order to better define the late season N applications. The overall impact of the research is to demonstrate the response to late season N should adverse weather affect early season N availability.

Project Deliverables

Research results have been presented:

Ebelhar*, M. Wayne, and Davis R. Clark. 2013. On-farm twin-row corn production with varying nitrogen management and cultivar interactions in the Mid-South. 2013 Southern Branch – Amer. Soc. of Agron., Orlando, FL. Feb 3-5, 2013. (http://scisoc.confex.com/scisoc/2013srb/webprogram/Paper77037.html)

Ebelhar, M. Wayne. 2013. On-farm evaluation of nitrogen management for high-yielding corn hybrids in twin-row production. *In* 2012 Annual Research Report, Delta Research and Extension Center. Stoneville, MS. pp. 6-7.

Ebelhar, M. Wayne. 2013. Managing corn production with pre-tassel nitrogen applications. *In* 2012 Annual Research Report, Delta Research and Extension Center. Stoneville, MS. pp. 12-13.

Ebelhar*, M. Wayne. 2013. Profitable corn production – Nutrient management and cultural practices. 16th Annual Natl. Conservation Systems Cotton and Rice Conf., Southern Corn and Soybean Conf., Jan 31 to Feb 1, 2013. Baton Rouge, LA. Oral Presentation: Jan 31 and Feb 1, 2013 (***Invited***)

Ebelhar*, M. Wayne. 2013. Pre-tassel nitrogen management for optimum corn production. 2012 Annual Report of Progress. Mississippi Corn Promotion Board. Mississippi State, MS. Oral Presentation: Feb 11, 2013.

Ebelhar*, M. Wayne, and Davis R. Clark. 2013. Managing Pre-tassel nitrogen for corn. Mississippi Chapter – American Society of Agronomy Annual Meeting, Grenada, MS. Nov 13-14, 2013. Oral Presentation: ***(Invited)***

Graphics

Figure 1: Corn grain yields as affected by N rates and N management utilizing pre-tassel N applications in 2013. Delta Research and Extension Center, Stoneville, MS. (Includes interactions and main effects for grain yield at 15.5%)

Figure 2: Summary of grain yield response to nitrogen management for selected corn cultivars averaged across pre-tassel N rates. Research conducted in producer field (Reality Partnership, Martin Walker) . 2013.

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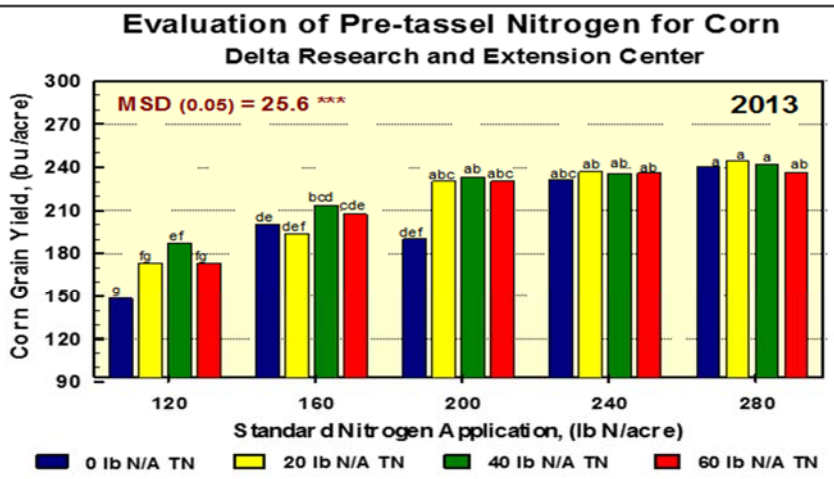
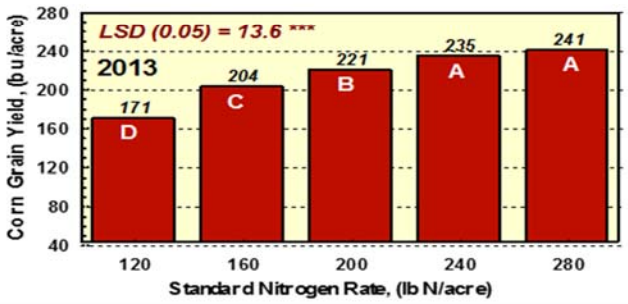
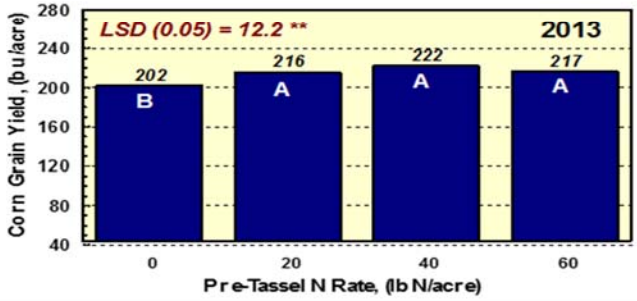
MISSISSIPPI STATE UNIVERSITY EXTENSION SERVICE

Nitrogen Management With Pre-tassel Urea Applications 2013







On-Farm Evaluation of Nitrogen Rates for Corn With and Without Pre-Tassel Nitrogen

Nitrogen Rate	Pioneer 0912 HR		Pioneer 1319 HR		Pioneer 1745 BVT		Pioneer 1739 HR		Pioneer 2088 YHR	
(lb N/A)	- - - - - - Grain Yield @ 15.5% Moisture (bu/acre) - - - - - -									
120	222	d	226	c	222	c	231	c	229	c
150	234	c	241	b	243	b	243	b	246	b
180	239	bc	249	ab	248	ab	254	a	255	a
210	246	a	254	a	253	ab	257	a	262	a
240	246	a	254	a	257	a	260	a	262	a
270	243	a	263	a	255	ab	258	a	258	a
LSD (0.05)	6		8		13		7		7	

Average Across Pre-tassel N Rates (0 and 40 lb N/acre)