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CORN PRESENTATIONS

Managing Nitrogen For Irrigated Corn In The Midsouth – Preplant To Pre-Tassel

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Managing nitrogen (N) fertility needs in corn probably receives more consideration and creates more questions than any other aspect of corn production in the Midsouth. Research a Mississippi State University conducted at the Delta Research and Extension Center near Stoneville, Mississippi has addressed many of the issues over the last several years and continues a robust program today. Area of interest and investigation have included, N sources, N rates, application timing (from pre-plant [PP] to pre-tassel [PT]), application ratios, starter materials, uptake enhancers, along with chemical and biological transformation inhibitors (nitrification and volatilization). These factors have been evaluated in rotations with cotton and soybean, on different soil types, across cultivars, in single-row (SR) planting patterns and twin-row (TR) planting patterns, on the experiment station and in producer fields. All research has been aimed at producing optimum yields with the most economical inputs and maximized returns on investments. Since 1980, corn production has ranged from as little as 28 bu/acre in 1980 (88,000 acres harvested) to 180 bu/acre (815,000 acres harvested) in 2013. The lowest acreage harvested (55,000) for grain occurred in 1983 while the largest acreage harvested in recent years (910,000) occurred in 2007. Cotton acreage has dropped significantly as the corn acreage has increased. The shift in crop mix has also brought about shifts in the infrastructure of the region. Cotton gins have been closed and on-farm grain bins and grain dryers have appeared on the landscape. Many fields have been landformed to grade and irrigation wells established. Irrigated acres of all crops have greatly increased. Along with the shift to corn planting, soybean production has seen a dramatic shift to the Early Soybean Production System (ESPS) that incorporates early planting and earlier maturing soybean to provided significant gains in soybean production. This coupled with supplemental irrigation has led to significant yield increases in soybean. In recent years, some producers have approached the 100 bu/acre plateau. With the advances in production and shifts to grain, fertilizer use has also increased. In most situations, N requirements for corn can be double that of cotton. Nutrient removal for high-yielding corn and soybean, compared to cotton, have led to a greater need for soul testing and fertilizer use. Nitrogen use efficiency for corn has actually been shown to have increased in the last 20 years as yields have increased yet N applications per acre have not shifted dramatically. Crop rotation with soybean can be credited with at least a partial decrease in the required N per bushel. In the early 1980's, N recommendations called for as much as 1.7 lb N/bushel of expected yield but has been reduced to 1.3 lb N/bushel.

However, in some years such as 2013, 250 bu/acre corn yields have been achieved with 180 to 210 lb N/acre following soybean in rotation. With more and more N, phosphorus (P), potassium (K), and sulfur (S) being removed from the field in the harvested crop, the greater the potential need for supplemental fertilizer. In many areas, for example, soybean has been grown for years with no fertilization. Soil reserves continue to be depleted and more nutrient deficiencies have been observed.

The focus of this review is N management from all aspects from early application through pre-tassel N applications. Initial research with corn was designed to evaluate N rates and application timing. The research was conducted under irrigated conditions as is the recommendation for corn production in the Mississippi Delta to maximize yield potential. Many areas of dryland (rain-fed) corn continue across the state but yields have not been consistent. Much of the initial research showed no clear advantage to split N applications. Most researchers agree that split applications are better with respect to actual N use efficiency compared to s single application. With high N rates, a single application, especially when applied prior to plant (PP), can be adversely affected by climate and the environment. Nitrogen use by corn plants is minimal from planting through the first few weeks of seedling development. Nitrification, denitrification, leaching, and volatilization can all lead to N loss before the plant can utilize the applied N. Some producer have been known to delay all N applications until V5 or V6 which could jeopardize potential yields. Single applications could be further delayed or losses greater if surface applications are used rather than some type of incorporation. Rate studies have shown little advantage to go above 240 lb N/acre in most situations. Rarely does rates above 250 lb N/acre result in significant grain yield increases. In some cases, a significant grain yield increase was not an economical yield increase. Research on-farm with twin-row production demonstrated this in three of four years. The studies were designed to evaluate increasing seeding rates and increasing N in twin-row corn. While both factors significantly increased yield independent of the other, only increasing seeding rates was deemed economical. Both the cost of N and the cost of seed as related to corn prices have to be considered in the valuation.

Over the last several years, many questions have been posed as to the validity and economic implications of N applications after the time that it physically possible to operate equipment across a corn field. Producers have always been interested in Atouching up= fields that had low spots or other drainage issues. Aerial applications of urea or ammonium nitrate have been used for many years without determination of whether the practice actually resulted in an economic benefit. About five years ago, a replicated field trial was initiated to evaluate urea applications just prior to tassel emergence. Urea was pre-weighed, then hand applied to simulate aerial application of 0, 20, 40, or 60 lb N/acre followed by rainfall or irrigation to incorporate. A series of traditional N rates (120 to 280 lb N/acre) were applied as the standard system with 120 lb N/acre applied prior to planting and the remaining 0 to 160 lb N/acre applied at the V5-V6 growth stage. Summarized data has shown no significant interaction between the standard N rates and the PT N rates. The statistical analysis of main effects did show a significant response to PT N with the greatest gains at the lower standard N rates. Results from this study has shown that the corn plants continue to take up N later into the growing season than previously thought and that N applications as urea could be effective in significantly increasing grain yields. These results do not suggest delaying N applications until tasseling as the typical means of N management but does suggest that the practice could be effective where N losses have occurred during the growing season. Further work is underway in an attempt to further refine the timing of the PT nitrogen application. This research involves simulated aerial applications from as early as V9 through VT and relating the growth stage to growing degree day units. The practices are also being evaluated on varying soil types and textures.

Nitrogen losses in the field are generally weather-related (both temperature and moisture) and can take the form of gaseous loss through denitrification and volatilization or leaching and run-off. In any case the losses prevent the primary goal of plant uptake. Multiple products are available in the marketplace to address these gaseous losses include Agrotain7 (Koch Agronomic Services) and Aborite7AG (Gavilon Fertilizer, LLC). Both products contain NBPT (N-(nbutyl)thiophosphoric triamide) responsible for slowing the conversion of urea to ammonia (urease inhibitor) that results in the volatilization loss of N. Other products that can be used to slow or disrupt biological transformations include nitrapyrin (InstinctJ and N-Serve7, Dow Agrosciences) and DCD (dicyandiamide, SKW Trostberg AG). These products inhibit the conversion of ammonium to nitrite (first step of nitrification process in soils). Some attention has been focused on NutriSphere-N (Specialty Fertilizer Products) which has also been proposed to enhance N uptake (mechanism is unclear). The other area of interest relates to polymer-coated materials such as ESN (Environmentally Smart Nitrogen7, Agrium Advanced Technologies) either used alone or in combination with other fertilizer N material such as urea. The ESN is a urea granule coated with a flexible polymer coating. The polymer coating protects the N from loss mechanisms and releases N based on temperature and soil moisture. Several of the above mentioned products or amendments have been and are currently being evaluated as possible N management tools. The ESN could allow for a single PP application that slow releases N for uptake closer to the time the plants need it. Volatilization inhibitors are effective in doing just that as long as conditions are present for volatilization losses. Where rainfall or irrigation is available to facilitate incorporation, the amendments should not be needed.

Managing N in corn may be more of an art than a science as many systems work equally well if the right conditions prevail. The goal for good nutrient stewardship provides the framework to achieve cropping goals, no matter what the crop. These goals are increased production, increased profitability, enhanced environmental protection, and improved sustainability. To achieve these goals, the 4R concept incorporates the **R**ight fertilizer sources, applied at the **R**ight rate, at the **R**ight time and in the **R**ight place (The Fertilizer Institute [TFI] and International Plant Nutrition Institute [IPNI]). Many factors can influence the outcome but profitability is the driving force.