NITROGEN RATE MANAGEMENT WITH COTTON GROWTH REGULATION FOR COTTON IN A COTTON/CORN PRODUCTION SYSTEM

M. Wayne Ebelhar
Davis R. Clark
Mississippi State University
Stoneville, MS

Abstract

Various nitrogen management systems have been evaluated with plant growth regulation (mepiquat pentaborate) for the past six years at the Delta Research and Extension Center (DREC) near Stoneville, Mississippi on very productive cotton soils. Each cotton crop followed corn in a 1:1 cotton/corn rotation with both crops receiving supplemental irrigation. Pentia™ plant growth regulator (PGR) was applied during each growing season based on experimental design with half of the plots receiving the PGR and the other half serving as the control. The higher N rates required for optimum corn production as compared to cotton production could lead to a buildup of residual N in the soil profile if biological processes do not decrease the pool. The potential residual N pool along with N fertilizer at recommended levels could lead to excessive growth in subsequent cotton crops following corn in rotation. Excessive growth can be controlled with PGR applications, reduced fertilizer N rates, or combinations of both. The objectives of this study were to determine the interaction effects of N management and PGR application in cotton following corn and to evaluate the main effects of N management and PGR where interactions were not significant. A 4x2x2 factorial combination of N rates (60, 90, 120, and 150 lb/A), N application systems (preplant [PP] and preplant + sidedress [PP+SD]), and a new chemistry plant growth regulator (Pentia) was evaluated from 2003 through 2008. Product literature indicated that the PGR resulted in improved boll retention, faster uptake, earlier maturing cotton, and superior height control. In 2003 and 2004, a total of 28 oz/acre Pentia was applied as a split application with the first application made during early bloom and the remainder applied about two weeks later during peak bloom. In both 2003 and 2004, optimum lint yields were achieved with 120 lb N/acre when yields were averaged across the PGR levels. In 2003, application of PGR had no significant effect on lint yield when N rates were at least 90 lb N/acre. At the lowest N rate (60 lb N/acre); PGR application resulted in an 8.1% reduction in lint yield. In 2004, with PGR applications initiated at first bloom (FB), lint yields were reduced at all N levels by 6.7 to 10.0% with the greatest reduction occurring at the lowest N level (60 lb N/acre). Other studies at DREC in 2004 showed similar reduction in lint yields with applications initiated at FB, especially at higher PGR rates. Treatments from these same studies, initiated at pin-head square (PHS) at lower application rates, showed positive responses compared to the untreated controls. With these results in mind, the PGR applications were modified in 2005 and 2006. The initial application (6 to 8 oz/acre) was applied at PHS and a second application (8 oz/acre) applied two to three weeks later, near first bloom. In these cases most of the PGR applications occurred before the initial applications were made in the two previous years.

The 2005 harvest was delayed until after the adverse effects of both hurricanes Katrina and Rita and lint yields were reduced compared to 2003. Lint yields ranged from 1082 to 1228 lb /acre with the highest yields achieved at the 150 lb N/acre level. This was the only year of the study where 150 lb N/acre produced significantly higher yields than 120 lb N/acre. With the delays and damage to the crop from the adverse weather conditions, later maturity associated with the higher N level was actually an advantage. Lint yields increased significantly with respect to PGR applications. The increase ranged from 6.1 to 9.2% and was positive at each N level. The greatest responses were observed at the 90 and 120 lb N/acre rates. The 2006 lint yields were similar to those measured in 2005; however, there was no difference between N rates. When averaged across N management systems, there was a significant increase in lint yields with the application of PGR begun at PHS. The increases ranged from 5.2% to 8.5% with the largest increase at the 120 lb/acre N rate. The cotton crop was defoliated in 2006 prior to reaching full maturity. This tended to mask the yield potential of later maturing bolls since these bolls were not allowed to mature on their own.

In the first four years of the study there was no significant difference between N application systems. Yields from the 100% PP N treatments were just as effective as sidedress N applications for producing optimum yields. In the case preplant N, N application was made shortly before planting rather than two to six weeks prior to planting as had been the practice in earlier years. In an effort to reduce the potential for N loss, N applications are made closer to the time that the plant can utilize the nutrient.

With this in mind the application systems were modified in 2007 and 2008 to include a uniform preplant N rate (60 lb N/acre) with the various N rates determined as sidedress applications of 0, 30, 60, and 90 lb N/acre. In both 2007 and 2008 there was still no significant difference between this system and the 100% PP system. Cotton yields in 2007 ranged from 1128 to 1416 lb lint/acre with no significant increase above 120 lb N/acre. In 2008, yields ranged from 1214 to 1371 lb lint/acre with the highest significant yield at 120 lb N/acre. These yields represent averages across N application systems and PGR levels with no significant interaction. The 2007 lint response to PGR application ranged from -1.0% to +9.1% with the greatest response at the highest N rates. The same effect was observed in 2008 with the lint response to PGR ranging from -0.1% to +7.2%. In both 2007 and 2008 the response to PGR was greater at the higher N levels (120 and 150 lb N/acre)

Plant height and nodes increased with increasing N rates in each of the four years. The PGR applications reduced plant height, total nodes, and height:node ratio. Plant heights were reduced more with the higher PGR rates in 2003 (14.4 to 22.5%) and 2004 (7.3 to 15.4%) as would be expected with higher application rates. In 2005, plant height was also lower with a range from 1.9 to 14.0%. The 2006 plant heights were 9.0 to 14.0% lower. At the lower PGR rates initiated at PHS, there was more variability in plant characteristics than observed in the previous years. End-of-season plant characteristics were not determined in the latter two years of the study.

Under the conditions of this research, it was concluded after the first two years, that application of mepiquat pentaborate was not successful in increasing lint yields when the initial application was delayed until first bloom or early bloom. However, in 2005 and 2006, where PGR applications were initiated at PHS, the use of mepiquat pentaborate at lower application rates did show significant lint yield increases (88 lb lint/acre, 7.9% in 2005; 74 lb lint/acre, 6.6% in 2006; 64 lb lint/acre, 5.0% in 2007; and 41 lb lint/acre, 3.2% in 2008) compared to the untreated control. Nitrogen recommendations would include the application of 120 lb N/acre applied either 100% PP or as a split application with at least 50% of the N applied prior to planting. This practice insures having N available early in the growing season for early plant growth and development. While data has shown significant responses to Pentia (mepiquat pentaborate) applications, economic considerations should be included in the decision making process. Application and material costs may not be covered by the additional yield. Fruit load continues to be the best plant growth regulator for cotton production.