EVALUATION OF PERFORMANCE, GROWTH, AND FRUITING CHARACTERISTICS OF NEW COTTON VARIETIES AND QUANTIFYING POTENTIAL PRODUCTION RISKS OF UP AND COMING TECHNOLOGIES

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Introduction

The 2010 production season was the last season that DP 555 BR was planted on a limited basis in Georgia. Prior to 2010, DP 555 BR was the predominant cotton variety planted on approximately 85 % of Georgia's cotton acreage. Beginning in 2010, newer varieties were planted on approximately 70 % of Georgia's cotton acreage, and by 2011, the transition to newer varieties was complete. However, since the loss of DP 555 BR, newer varieties are being released and removed from the market in a much more rapid manner. This rapid turnover of new varieties allows very little time for growers to effectively evaluate yield potential and variety characteristics that help them better manage these varieties for maximum yield potential.

Secondly, despite the loss of DP 555 BR, most management practices, such as PGR management, are still geared towards that of DP 555 BR (full-season, very indeterminate growth characteristics) which could be yield inhibitory for some varieties. Research conducted in 2010 and 2011 by the Extension Cotton Agronomists suggests that many of the newer varieties may be earlier maturing than DP 555 BR, and therefore may need less aggressive PGR management in general, may not need pre-bloom PGR applications, and may require the use of Stance for sufficient growth management versus some of the standard PGR products. This is likely due to natural variety genetics but it is also possibly due to the improved Bt technologies, allowing for better retention of bolls. However, this is not always the case, as some newer varieties exhibit similar growth potential, indeterminacy, and fruiting characteristics to that of DP 555 BR.

The research trials conducted throughout 2010 and 2011, regarding the necessity of pre-bloom PGR applications and the utility of Stance for earlier maturing varieties, has brought usable information to growers with regard to how specific new varieties should be managed with PGRs. However, the continued rapid release of newer varieties, which vary widely in growth potential and fruiting characteristics, warrants continued research to investigate, quantify, and rank growth potential of newer varieties compared to standards. This effort will utilize standard varieties that have been previously quantified for growth, but will focus largely on the newer non-tested varieties, in hopes to provide this information before these newer varieties are released on a large-scale basis.

Additionally, the release of newer herbicide technologies within a few years could pose some challenges for Georgia cotton growers. One such technology is the Enlist technology from Dow AgroSciences which conveys tolerance to 2,4-D herbicide. Drift injury from 2,4-D is not currently uncommon, but yield loss due to drift is often difficult to predict or quantify. Most assessments of yield loss are subjective, or lack objectivity, and have little regard to growth stage etc. This issue will most certainly become a much larger problem for Georgia cotton growers upon the release of these technologies and increase the likelihood that drift will occur. The increased risks associated with these new technologies warrant extensive research to develop sound scientific techniques for quantifying yield loss due to 2,4-D drift, and will account for growth stage and drift rate of the herbicide on both early and later maturing varieties.

Materials and Methods

PGR experiments were initiated in 2012 at Tifton and Midville. These experiments investigated the response of several new varieties (ranging from early to late maturity) to PGR treatments similar to what was required for DP 555 BR in previous years, to quantify differences in PGR responses of these new varieties with commercial standard varieties that have been evaluated in previous years. Varieties were ranked according to their non-treated planted plus PGR-treated plant height, to develop a categorized ranking based on growth potential and response to PGRs. This ranking can then be used to establish PGR recommendations for groups of varieties that are similar in terms of growth potential. The following data was collected: plant heights and number of nodes collected at most PGR timings and again just prior to harvest. Nodes above white flower was collected when the earliest-maturing treatment(s) reached cutout (NAWF= 4 to 5). Mapping of boll distribution was collected between defoliation and harvest. The latter parameters provided insight on maturity of these new varieties.

Additional experiments were conducted in Tifton to quantify the effects of 2,4-D drift. PHY 499 WRF was subjected to two simulated drift rates (0.0357 and 0.00178 lbs/A a.i.) of 2,4-D herbicide, applied every two to three weeks throughout the growing season, at the following growth stages: 4-leaf, 9-leaf, First Bloom, and First Bloom+2weeks. Data collection included % injury, plant heights weekly throughout the season, and mapping of boll distribution. Plots were harvested and subsequently ginned for lint percentage, lint yield, and HVI fiber quality. The impact of herbicide drift was clearly quantified for all growth stages.

Results and Discussion

Figure 1 illustrates the response of modern and brand new varieties to an aggressive PGR treatment that was commonly used for DP 555 BR (12 oz applied at 9-leaf, 12 oz applied at first bloom, and 16 oz applied at first bloom+2weeks). Although frequent rains / irrigation and optimal soil moisture was observed in 2012, this data clearly shows noticeable differences in plant height and thus growth potential of modern commonly-planted varieties in Georgia. In the absence of a PGR treatment, there was a range of 8 inches in non-treated plant height, and this difference was only slightly smaller in non-treated plant height. The degree of plant height suppression as a result of the PGR treatment was approximately the same in all varieties; however, this degree of suppression in an early maturing, short-statured variety may result in sub-optimal final plant height, especially if water stress is experienced. Ideally, final plant height of all cotton should be short enough to be harvest efficient and to avoid lower fruit abortion / delayed maturity; however, plants should still be tall enough to support an optimal boll load for optimal yields. Aggressive PGRs, especially on less aggressive varieties, could result in inadequate development of fruiting sites.

Figure 2 illustrates the yield response of these same varieties subjected to an aggressive PGR treatment. The more noticeable effect in these results is that an aggressive PGR treatment reduced yield (at least numerically) in all varieties. The least reduction occurred in the later-maturing DP 1252 B2RF and the greatest reduction occurred in FM 1740 B2F which is similar to what we would normally expect. However, growers should remember that this experiment was conducted in very wet conditions with adequate water throughout the season, without stress, and PGRs still resulted in no positive yield response for any variety.

Results of the simulated 2,4-D drift experiment are illustrated below. Figure 3 illustrates the effect of the low rate (1/421 X rate) on boll distribution in all regions of the plant. The most notable effects of the low rate on boll distribution occurred on the 2^{nd} foot of stalk, where there was a mild reduction in harvestable bolls observed in all application timings. The greatest reduction in this region occurred when the low rate was applied at the 4-leaf stage.

Figure 4 illustrates the effects of the high rate (1/21 X rate) applied at various growth stages. The high rate obviously resulted in the most significant distortion of boll distribution. This rate applied at the 4-leaf stage substantially reduced the number of bolls in the bottom foot of stalk, but had a similar number of bolls to the non-treated cotton in the second foot of stalk. However, the 4-leaf treatment shifted a large proportion of bolls to the third foot of stalk suggesting a delay in maturity is realistic. Also noted as a result of the 4-leaf treatment, was a high number of split-terminal plants which further delays maturity as most of the boll population is set on vegetative branches. The high rate applied at all other timings, resulted in significantly less bolls set on both the second and third foot of stalk.

Figure 5 illustrates the effect of both rates on total bolls per plant for all application timings. Compared to non-treated cotton, only the high rate applied at first bloom significantly reduced the total number of bolls per 10 plants, suggesting that this growth stage may be most likely to result in yield loss if significant 2,4-D drift occurs.

Figure 6 illustrates the most important data in this experiment, yield responses of simulated 2,4-D drift at all growth stages. Despite the mild distortion in boll distribution previously illustrated, the low rate (1/421 X rate) did not adversely affect yield when compared to the non-treated control. However, the high rate (1/21 X rate) resulted in significant yield loss at all growth stages. The least yield reduction occurred when the high rate was applied at the 4-leaf stage, followed by the 9-leaf stage, First Bloom + 2 weeks, and the most yield was lost when applications were made at First Bloom. This data suggests that the most yield-sensitive growth stage to 2,4-D drift is at First Bloom, and to a lesser degree at more distant growth stages. More importantly, this research illustrates the need to quantify injury in drift situations to determine whether or not yield loss is likely to occur.

Acknowledgements

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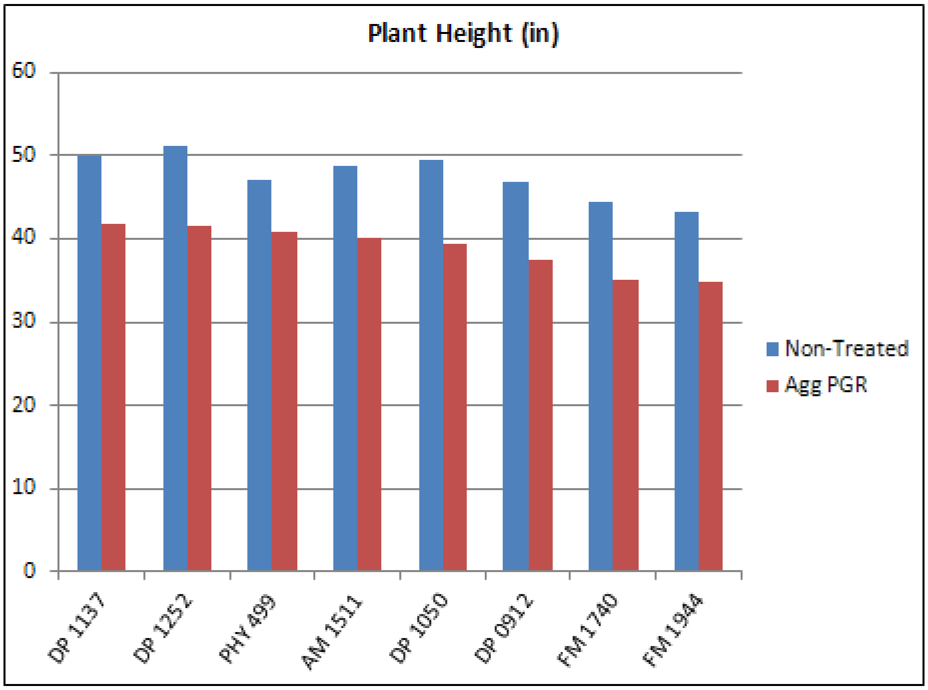

Figure 1. Plant height of non-treated and PGR-treated cotton varieties ranked in descending order.

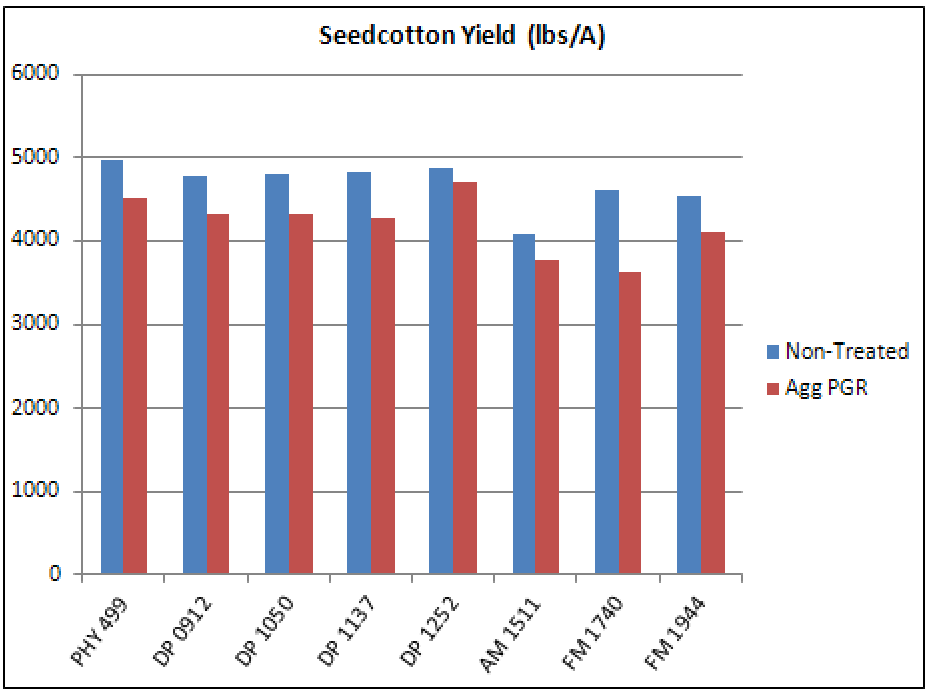

Figure 2. Seedcotton yield response of non-treated and PGR-treated cotton varieties.

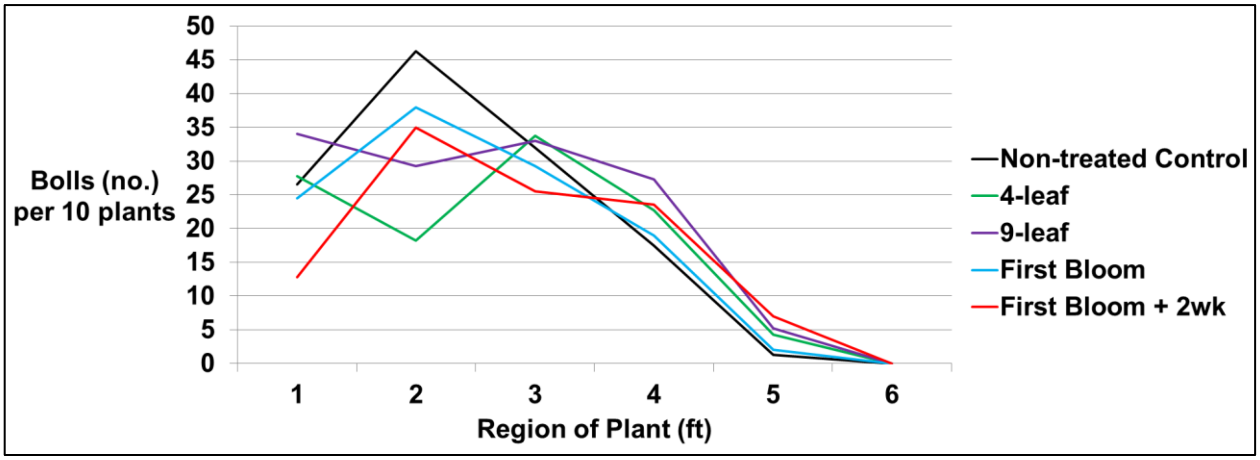

Figure 3. The effects of 2,4-D (0.00178 lbs a.i./A – 1/421 X rate) applied at various growth stages on the number of bolls per foot of plant stalk.

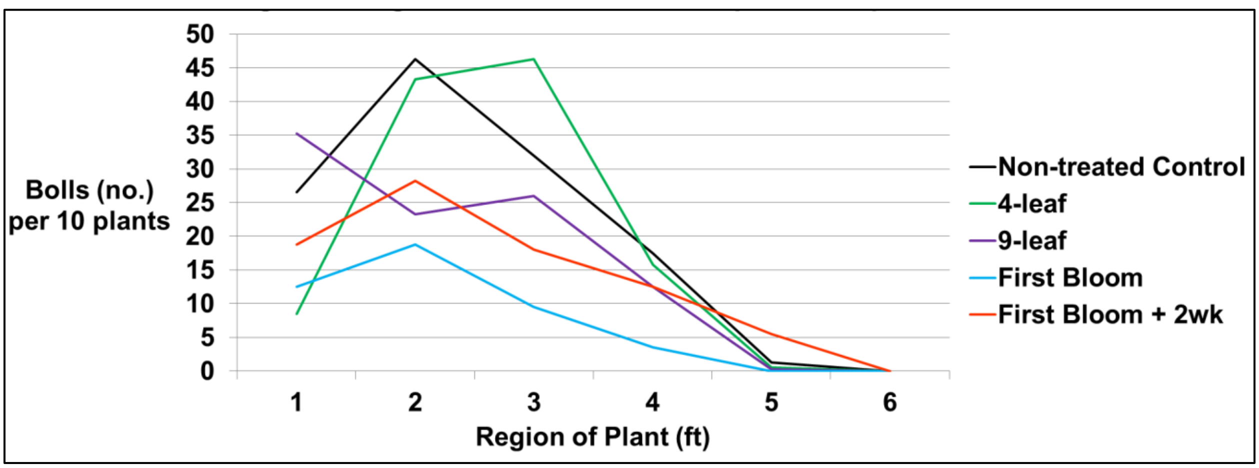

Figure 4. The effects of 2,4-D (0.0357 lbs a.i./A – 1/21 X rate) applied at various growth stages on the number of bolls per foot of plant stalk.

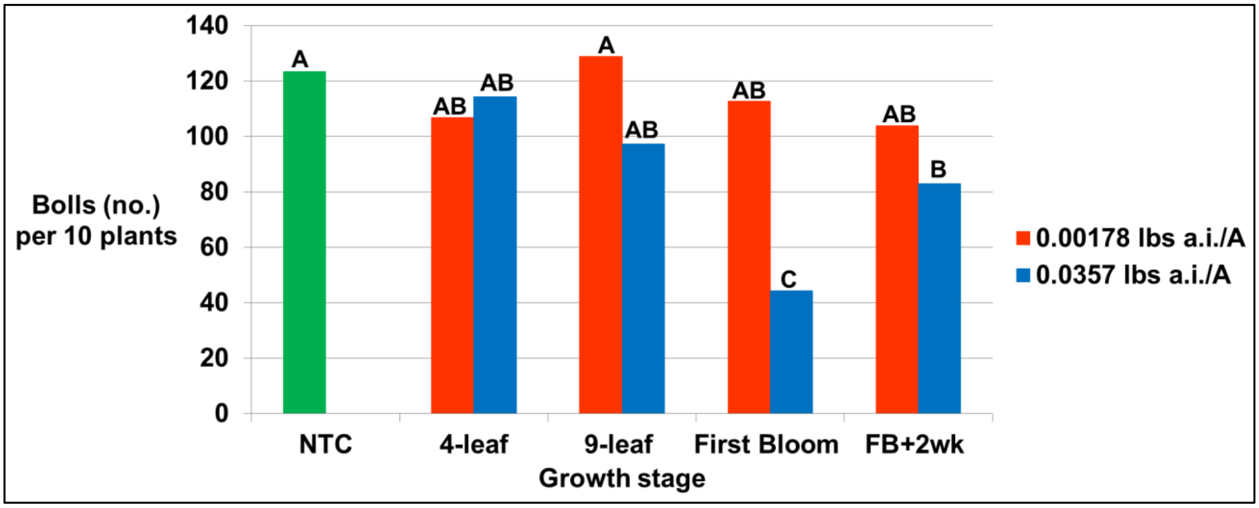

Figure 5. The effects of simulated 2,4-D drift at various growth stages on bolls per 10 plants.

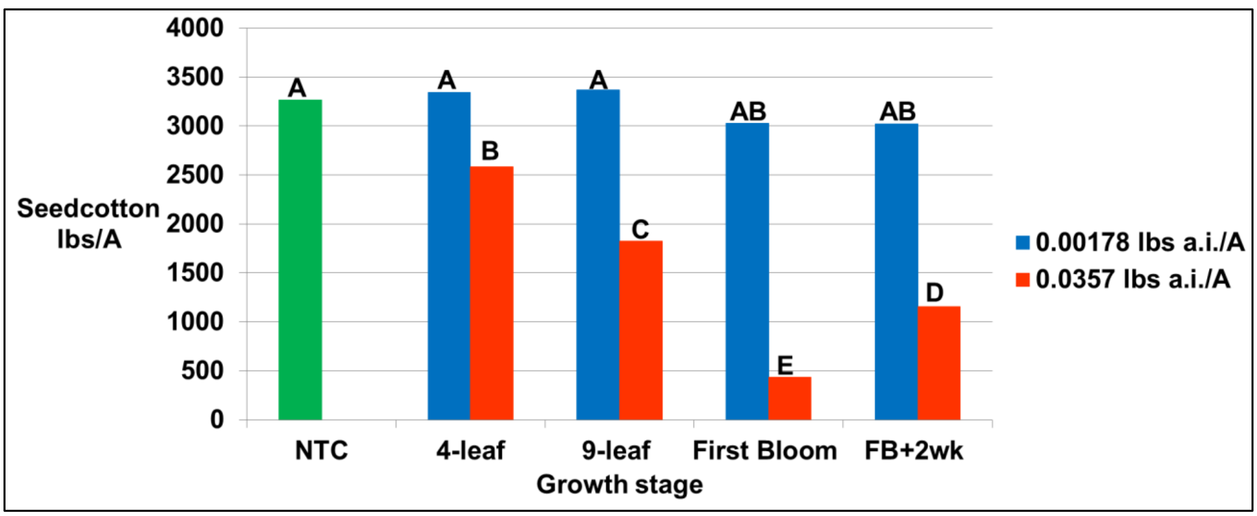

Figure 6. Yield response of simulated 2,4-D drift at various growth stages.