DIFFERENTIAL RESPONSE OF COTTON VARIETIES TO PLANT GROWTH REGULATOR APPLICATIONS

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Introduction

The application of plant growth regulator (PGRs) chemicals has become common practice in cotton production across the cotton belt. Plant growth regulators appear to be important in stimulating early-season growth and in manipulating resources into harvestable yield. Proper use of PGRs often reduces plant height (Heilman, 1981), which may result in reduced yield losses caused by boll rots, hardlocks, and shading commonly associated with dense canopies (Snow et al., 1981). Although the physiological responses of cotton plants to PGRs have been fairly consistent throughout the Cotton Belt, reports on the yield response to PGR applications have been inconsistent. Some researchers have found yield increases (Briggs, 1980, Walter et al., 1980) with the application of PGRs, while others have found yield decreases or no yield effects (Crawford, 1981; Feaster et al., 1980, Thomas, 1975). Improved yields with the applications of PGRs have often been attributed to improved photosynthetic capacities (Gausman et al., 1979), more vigorous early-season growth (Oosterhuis and Zhao, 1994), higher boll retention (Kerby, 1985; Kerby et al., 1986), better light penetration (Reddy et al., 1990), improved earliness (Kerby, 1985), and increased root mass (Oosterhuis and Zhao, 1994). However, it appears the proper rate and timing of PGRs depends upon many environmental factors, such as soil moisture, ambient air temperatures, and fertility (Cathey and Thomas, 1986). Yield responses appear to be related to environmental factors encountered by the plant throughout the growing season, with increased yields occurring under conditions that favor excessive vegetative growth (high N rates, excessive rainfall, thick stands, etc.) and yield decreases occurring under conditions that limit proper growth (excessive drought, high temperatures, N deficiency, etc.). The objective of this study was to compare and contrast yield performance and crop development of experimental and commercial cotton varieties in South Carolina in response to various plant growth regulator programs.

Materials and Methods

Replicated field studies were conducted in 2008 and 2009 at the Pee Dee Research & Education Center located in Florence, SC. The plots were planted on May 20, 2008 and May 15 and 23, 2009 with a JD 1700 vacuum planter at a rate of 4 seed per row foot. Plots consisted of 4 rows, spaced 38 inches apart and were 40 feet long. Three plant growth regulator programs and numerous cotton varieties were arranged as split-plots in a randomized complete block design with four replications. The three plant growth regulator programs were in main plots, and the varieties were in sub-plots. Varieties consisted of commercially released varieties (DPL 555BR, DPL 444BR, DPL 143B2RF, ST 4554B2RF, DPL 0924B2RF, AM 1550 B2RF, PHY 375WRF, ST 5327B2RF, DPL 0912B2RF, DPL 0949 B2RF, and DPL 0935B2RF) and experimental varieties (DPLX 07X440DF, MCS 0711B2RF, MCS 0702B2RF, DPL 09R796B2RF, DPL 09R621B2RF, DPL 09R619B2RF, DPL 09R615B2RF, DPL 09R605 B2RF, DPL 09R550B2RF, and DPL 09R549 B2RF). Plant growth regulator programs consisted of: 1) untreated, 2) a standard program, and 3) an aggressive program. The standard program consisted of Pentia sprayed at a rate of 8 oz/a on July 1, 2008 and July 14, 2009 at the matchhead square stage followed by Pentia sprayed at a rate of 16 oz/a on July 10, 2008 and July 28, 2009 at the early bloom growth stage. The aggressive program consisted of Pentia sprayed at a rate of 8 oz/a on June 20, 2008 and June 26, 2009 at the 6 to 8 leaf stage, followed by Pentia sprayed at a rate of 16 oz/a on July1, 2008 and July 14, 2009 at the matchhead square stage, followed by Pentia sprayed at a rate of 16 oz/a on July 10, 2008 and July 28, 2009 at the early bloom growth stage. Data collected included plant height and number of nodes at several times during the season, and a final plant map at the end of season (plant height, number of nodes, total fruiting sites, boll location on main stem nodes and sympodia). The middle two rows of each four row plots were machine-harvested at season's end. Seedcotton was ginned on a 10-saw gin and gin turnout calculated, and fiber quality determined by HVI analysis at Star Lab (Knoxville, TN). Data were evaluated by analysis of variance (SAS Institute Inc., Cary, NC).

Summary

Plant Growth Regulator Program Differences

Although weather conditions in SC in 2008 and 2009 were highly conducive for cotton production (3 bale or greater lint yield), the aggressive PGR program (3 sprays of 40 oz/a total) reduced lint yield 6 to 7% (Table 1) in 2008 compared to a more standard PGR program (2 sprays of 24 oz/a total) or the untreated (no PGRs applied). Using an aggressive PGR program in 2009 increased yields 4 to 13% (Table 2) compared to not spraying PGRs during the growing season. This data further illustrates the inconsistent yield responses that often occur when applying PGRs to cotton.

PGR applications appeared to change the internal partitioning of dry matter within cotton bolls. The use of Pentia in this study reduced gin turnout and micronaire, and increased fiber length (Table 1) in 2008. Similar reductions in gin turnout by applications of Pentia were found in both studies conducted in 2009 (Table 2). Unfortunately, fiber quality data was not available at this time.

The use of Pentia reduced plant height, the number of nodes, and the height:node ratio (Table 3), decreased the first fruiting branch (Table 4), and increased fruit retention and the number of bolls produced below node 10 (Table 4).

Variety Differences

The lint yields of many of the new B2RF varieties evaluated in this study were greater than DPL 555BR (Tables 1 and 2). The yield potential of these new B2RF varieties is extremely promising to many SC cotton growers who have relied so heavily on DPL 555BR as their primary variety over the last five or six years. DPL 555BR will not be commercially available after 2010.

PGR Program x Variety Interactions

No PGR x variety interactions were found for any of the parameters measured in this study, with the exception of seedcotton in 2008. Seedcotton production was reduced 21% with DPL 0912 B2RF by the aggressive use of PGRs during the growing season compared to the untreated plots. Likewise, seedcotton production was reduced 15% with DPL 143B2RF by the use of an aggressive PGR program compared to a more standard PGR program. Seedcotton production was increased 14% with DPL 555BR and DPL 0935B2RF by the use of a standard PGR program during the growing season compared to no PGRs applied at all (untreated).

Table 1. Lint yield, seedcotton, gin turnout and fiber quality of various cotton varieties (VAR) in response to three different plant growth regulator programs (PGR) at Florence, SC, in 2008.

Parameter	Lint Yield	Seed Cotton	Gin Turnout	Micronaire	Fiber Length	Fiber Strength	Fiber Uniformity
	(lb/a)	(lb/a)	(%)		(in.)	(g/tex)	(%)
PGR Program							
Untreated	1560	3957	39.5	4.3	1.12	28.5	82.6
Standard†	1568	4040	38.8	4.2	1.14	28.9	82.6
Aggressive‡	1467	3869	37.9	4.1	1.14	28.5	82.4
LSD (0.05)	77	NS	0.6	0.1	0.01	NS	NS
Variety							
DPL 0912 B2RF	1630	4206	38.7	4.5	1.11	29.4	82.4
DPL 0949 B2RF	1577	4017	39.2	4.4	1.15	28.7	83.5
ST 4554 B2RF	1557	4101	37.9	4.2	1.12	29.1	82.9
DPLX 07X440 DF	1549	3739	41.4	4.0	1.12	25.4	82.2
MCS 0711B2RF	1547	4153	37.3	4.1	1.17	27.6	83.2
DPL 0935 B2RF	1546	3912	39.5	4.3	1.11	28.8	82.1
DPL 555 BR	1532	3736	41.0	4.2	1.11	29.3	80.9
MCS 0702 B2RF	1507	3969	38.0	4.2	1.12	29.4	83.3
DPL 0924 B2RF	1488	3938	37.8	4.5	1.11	29.2	82.7
DPL 143 B2RF	1386	3782	36.7	3.9	1.19	29.2	82.1
LSD (0.05)	NS	327	1.1	0.2	0.02	0.9	0.7
PGRxVAR	NS	*	NS	NS	NS	NS	NS

†Pentia sprayed at 8 oz/a on July 1, 2008 (mhd square) and at 16 oz/a on July 10, 2008 (Early Bloom).
‡Pentia sprayed at 8 oz/a on June 20, 2008 (6 leaf stage), at 16 oz/a on July 1, 2008 (matchhead square), and at 16 oz/a on July 10, 2008 (Early Bloom).

Table 2. Lint yield, seed cotton, and gin turnout of various cotton varieties (VAR) in response to three different plant growth regulator programs (PGR) in two studies at Florence, SC, in 2009.

	Study 1				Study 2		
Parameter	**Lint Yield**	**Seed Cotton**	**Gin Turnout**	**Parameter**	**Lint Yield**	**Seed Cotton**	**Gin Turnout**
	(lb/a)	(lb/a)	(%)		(in.)	(g/tex)	(%)
PGR Program				PGR Program			
Untreated	1588	3784	42.0	Untreated	1360	3224	42.2
Standard†	1538	3733	41.2	Standard	1505	3705	40.7
Aggressive‡	1649	3996	41.4	Aggressive	1541	3756	41.1
LSD (0.05)	93	241	0.4	LSD (0.05)	52	130	0.4
Variety				Variety			
DPL 09R796 B2RF	1561	3714	42.0	AM 1550 B2RF	1496	3671	40.9
DPL 09R621 B2RF	1671	3972	42.2	PHY 375 WRF	1557	3776	41.3
DPL 09R619 B2RF	1721	4111	42.1	ST 5327 B2RF	1495	3691	40.6
DPL 09R615 B2RF	1742	4110	42.5	DPL 0912 B2RF	1492	3737	40.0
DPL 09R605 B2RF	1679	3998	42.1	DPL 0935 B2RF	1451	3522	41.3
DPL 09R550 B2RF	1613	3855	41.8	DPL 0949 B2RF	1390	3264	42.6
DPL 09R549 B2RF	1614	3925	41.2	DPL 0924 B2RF	1445	3564	40.5
DPL 0912 B2RF	1610	3836	42.0	ST 4554 B2RF	1439	3611	39.9
DPL 0935 B2RF	1495	3628	41.3	DPL 444 BR	1462	3455	42.3
DPL 0949 B2RF	1590	3796	42.0	DPL 555 BR	1458	3326	43.9
DPL 0924 B2RF	1567	3918	40.2				
ST 4554 B2RF	1537	3827	40.3				
DPL 143 B2RF	1397	3579	39.1				
DPL 555 BR	1487	3456	43.0				
LSD (0.05)	201	NS	0.9	LSD (0.05)	95	238	0.8
PGRxVAR	NS	NS	NS	PGR x VAR	NS	NS	NS

†Pentia sprayed at 8 oz/a on July 14, 2009 (matchhead square) and at 16 oz/a on July 28, 2009 (Early Bloom).

‡Pentia sprayed at 8 oz/a on June 23, 2098 (6 leaf stage), at 16 oz/a on July 14, 2009 (matchhead square), and at 16 oz/a on July 28, 2009 (Early Bloom).

Table 3. Plant height, number of mainstem nodes, and height:node ratio (HNR) of various cotton varieties (VAR) in response to three different plant growth regulator programs (PGR) at Florence, SC, in 2008 and 2009.

2008 Study	19-Jun			30-Jun			9-Jul			17-Oct		
Parameter	Plt. Ht.	Nodes	HNR	Plt. Ht.	Nodes	HNR	Plt. Ht.	Nodes	HNR	Plt. Ht.	Nodes	HNR
	cm	no./plt	cm	cm	no./plt	cm	cm	no./plt	cm	cm	no./plt	cm
PGR Program												
Untreated	24	6	3.9	35	8	4.3	43	9	5.0	94	17	5.4
Standard†	23	6	4.0	36	8	4.4	40	8	4.9	69	17	4.2
Aggressive‡	23	6	3.8	32	7	4.4	35	8	4.6	72	17	4.2
LSD (0.05)	NS	NS	NS	1	1	NS	1	1	0.2	5	NS	0.2
PGRxVAR	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

2009 Studies	22-Jun			13-Jul			27-Jul			1-Oct		
Parameter	Plt. Ht.	Nodes	HNR	Plt. Ht.	Nodes	HNR	Plt. Ht.	Nodes	HNR	Plt. Ht.	Nodes	HNR
	cm	no./plt	cm	cm	no./plt	cm	cm	no./plt	cm	cm	no./plt	cm
PGR Program												
Untreated	26	4	6.2	57	10	6.0	86	13	6.6	95	15	6.2
Standard†	26	4	5.8	59	10	6.3	78	12	6.5	81	15	5.5
Aggressive‡	28	5	9.0	53	9	5.7	69	12	5.9	73	14	5.2
LSD (0.05)	NS	NS	NS	3	1	0.2	3	1	0.2	4	1	0.2
PGRxVAR	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

†Pentia sprayed at 8 oz/a on July 1, 2008 and July 14, 2009 (matchhead square) and at 16 oz/a on July 10, 2008 and July 28, 2009 (Early Bloom).
‡Pentia sprayed at 8 oz/a on June 20, 2008 and June 23, 2009 (6 to 8 leaf stage), at 16 oz/a on July 1, 2008 and July 14, 2009 (matchhead square), and at 16 oz/a on July 10, 2008 and July 28, 2009 (Early Bloom).

Table 4. Total bolls, number of fruiting sites, fruit retention, location of bolls on sympodia and vegetative branches, and location of bolls by main stem node as determined from mapping various cotton varieties (VAR) on October 17, 2008, and October 1, 2009 in response to three different plant growth regulator programs (PGR) at Florence, SC.

2008 Study	Total	Total Fruiting	Fruit	1st Fruiting	No. of Veg.	Mainstem node				
Parameter	bolls	Sites	Retention	Branch	bolls	1 to 5	6 to 10	11 to 15	16 to 20	≥21
	bolls/plt	no./plt	%	node/plt	bolls/plt	bolls/plt	bolls/plt	bolls/plt	bolls/plt	bolls/plt
PGR Program										
Untreated	9.6	17.8	54.3	8.2	1.4	0.0	3.4	4.0	0.9	0.0
Standard†	9.4	16.5	57.3	7.4	1.2	0.2	4.4	3.4	0.6	0.0
Aggressive‡	9.8	17.6	55.6	7.3	1.1	0.2	4.2	3.7	0.8	0.0
LSD (0.05)	NS	NS	NS	0.3	NS	NS	0.8	0.4	NS	NS
PGRxVAR	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

2009 Studies	Total	Total Fruiting	Fruit	1st Fruiting	No. of Veg.	Mainstem node				
Parameter	bolls	Sites	Retention	Branch	bolls	1 to 5	6 to 10	11 to 15	16 to 20	≥21
	bolls/plt	no./plt	%	node/plt	bolls/plt	bolls/plt	bolls/plt	bolls/plt	bolls/plt	bolls/plt
PGR Program										
Untreated	7.4	19.8	38.0	5.9	1.6	0.6	4.3	1.9	0.2	0.0
Standard†	7.6	17.7	43.7	5.9	1.5	0.7	4.3	1.9	0.1	0.0
Aggressive‡	7.0	17.1	41.1	5.6	1.4	0.8	4.2	1.5	0.0	0.0
LSD (0.05)	NS	1.8	3.8	0.3	NS	0.2	NS	0.4	0.1	NS
PGRxVAR	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

†Pentia sprayed at 8 oz/a on July 1, 2008 and July 14, 2009 (matchhead square) and at 16 oz/a on July 10, 2008 and July 28, 2009 (Early Bloom).
‡Pentia sprayed at 8 oz/a on June 20, 2008 and June 23, 2009 (6 to 8 leaf stage), at 16 oz/a on July 1, 2008 and July 14, 2009 (matchhead square), & at 16 oz/a on July 10, 2008 and July 28, 2009 (Early Bloom).

Disclaimer

Entries listed as MCS or DPLX are experimental varieties, and not for sale. Individual results may vary, and performance may vary from location to location and from year to year. This result may not be an indicator of results you may obtain as local growing, soil, and weather conditions may vary. Growers should evaluate data from multiple locations and years whenever possible.