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AGRONOMY AND SOILS

Evaluation of Planting Date, Variety, and PRE Herbicide on Thrips Infestations, Cotton Growth and Development, and Lint Yield

J. Drake Copeland, Darrin M. Dodds*, Angus L. Catchot, Jeff Gore, and David G. Wilson Jr.

ABSTRACT

Early season thrips infestations and preemergence (PRE) herbicide applications and their interaction with weather can impact early season cotton growth. Research was conducted in 2013 and 2014 in Mississippi to evaluate the impact of planting date, varietal maturity, and PRE herbicide on thrips infestations in cotton. Delta and Pine Land (DP) 0912 B2RF (short-season), and DP 1252 B2RF (full season) cotton varieties, were planted in mid-April, mid-May, late-May, and mid-June. Acceleron® N seed treatment (thiamethoxam + pyraclostrobin +abamectin) was utilized on seed at each location. Fluometuron + *S*-metolachlor was applied PRE at 1.12 + 1.07 kg ai ha^{-1}and a non-herbicide treated check was included for comparison purposes. Cotton biomass at the two-leaf stage was greatest when DP 0912 B2RF was planted in late-May at 3.2 g per five plants. Cotton treated with fluometuron + *S*- metolachlor PRE had less biomass at the two-leaf stage than cotton not treated with a PRE herbicide. Immature thrips counts were greatest on late-May planted cotton at both the two- and four-leaf stages. Cotton height at the four-leaf stage was greatest when DP 0912 B2RF was planted in mid-June or in the absence of PRE herbicide application. Delayed maturity was observed when planting occurred after mid-May. Cotton treated with *S*-metolachlor + fluometuron yielded significantly less than cotton not treated with a PRE herbicide. Lint yields were greatest when DP 0912 B2RF was planted in mid-April, mid-May, and late-May or with DP 1252 B2RF planted in mid-April and mid-May. Lint yields from these combinations ranged from 2195 kg ha^{-1} to 2429 kg ha^{-1}.

Delayed early season cotton (*Gossypium hirsutum* L.) growth increased vulnerability to tobacco thrips (*Frankliniella fusca* [Hinds]) infestations. In 2012, tobacco thrips caused yield losses of 9,547 bales in Mississippi (MS), (Stewart et al., 2013; Williams, 2016). Yield losses ranging from 10 to 304 kg lint ha^{-1} have been observed due to thrips infestation in cotton (Layton and Reed, 2002). In addition, control for early season thrips infestations cost cotton growers \$12.45 ha^{-1} in 2015 (Williams, 2016). Seed treatments containing insecticides have become commonplace in cotton production for thrips management to minimize yield losses (Layton and Reed, 2002; Cook et al., 2011; Stewart et al. 2013).

Planting cotton as early as environmental conditions will allow is crucial to optimize yield. Many producers prefer to plant as early as possible in order to facilitate earlier harvest. Early cotton planting typically occurs when soil temperatures reach at least 18°C (Silvertooth et al., 1999; Boman and Lemon, 2005), and has been shown to increase lint yields by up to 10% (Bibro and Ray, 1973; Pettigrew, 2002; Davidonis et al., 2004; Adams et al., 2013). Planting cotton earlier has also been shown to reduce infestation from late season insect pests (Pettigrew, 2002; Adams et al., 2013). Populations of some pests such as tobacco thrips, typically peak during the early portion of the growing season (Morsello et al., 2008). However, planting cotton in cool, wet conditions can reduce plant populations as well as seedling vigor (Wrather et al., 2008). Cotton is naturally slow to develop during early growth stages and reduced early season growth due to environmental conditions can exacerbate thrips injury (Cook et al., 2011; 2013). Cotton is susceptible to thrips damage from emergence until the four-leaf stage, and stunting injury can persist further into the growing season (Catchot et al., 2014).

Variety selection decisions are also important with respect to insect management plans, harvest planning, and yield goals (Adams et al., 2013). Differences in cotton cultivar maturity ranges from 10 to 14 days when

J.D. Copeland and D.M. Dodds, Department of Plant and Soil Sciences, Mississippi State University, 32 Creelman St, 117 Dorman Hall; Box 9555, Mississippi State, MS 39762 ; A.L Catchot, Department of Biochemistry, Molecular Biology, Entomology, and Plant Pathology, Mississippi State University, Clay Lyle Entomology Building, Room 103, Box 9775, Mississippi State, MS 39762; J. Gore, Mississippi State University, Delta Research and Extension Center, P.O. Box 197, Stoneville, MS 38776; and D.G. Wilson Jr., Monsanto Company, 800 N. Lindbergh Blvd., St. Louis, MO 63167.
*Corresponding author: darrind@ext.msstate.edu

comparing short-season to long-season varieties (Dodds et al., 2011). Cotton variety characteristics such as length of flowering period are important when trying to avoid mid-season and late-season insect pests (Luttrell, 1994). Later maturing varieties are typically exposed to late season insect pests for a longer period of time compared to early maturing varieties (Adams et al., 2013).

Along with weather conditions at planting, insect and weed management are critical for vigorous early season growth. Because glyphosate-resistant (GR) weeds are found throughout cotton producing regions of the United States (US), {predominantly Palmer amaranth (*Amaranthus palmeri* [S. Wats.])}, cotton producers are applying preemergence (PRE) residual herbicides at planting to manage early season weeds, a recommended practice prior to GR cotton adoption (Culpepper, 2009; Irby et al., 2010; Ferrell et al., 2012). Use of PRE herbicides typically results in significant yield increases compared to systems where PRE herbicides are not used when GR weeds are present (Price and Wilcut, 2002; Everman et al., 2009). However, application of PRE herbicides can result in cotton injury and slow development of seedling cotton, which can exacerbate injury symptoms from insects, disease, weather, and nutrient deficiencies (Kendig et al., 2007; Ikram et al., 2012; Lingenfelter, 2007). Schrage et al. (2012) reported cotton injury ranging from 15 to 22% and 35 to 42% six weeks after PRE applications of fluometuron or diuron, respectively. Additionally, PRE herbicide injury to seedling cotton can decrease cotton lint yields (Berger et al., 2012; Main et al., 2012).

Many environmental factors and producer practices contribute to severity of thrips injury to seedling cotton. Factors such as soil temperature, varietal maturity, PRE herbicide and subsequent rainfall, and choice of prophylactic at-plant thrips management options all influence potential damage caused by thrips. Producers often weigh the risk-reward of planting cotton early and the impact of this practice on yield. However, previous research evaluating the effect of planting date, varietal maturity, and PRE herbicide application on cotton growth, development, and yield as well as thrips infestation is lacking. Therefore, this research was conducted to determine the effect of planting date, PRE herbicide application, and varietal maturity on thrips infestation as well as cotton growth, development, and yield.

MATERIALS AND METHODS

Studies were conducted at the R.R Foil Plant Science Research Center in Starkville, MS and at the Delta Research and Extension Center in Stoneville, MS in 2013 and 2014 under conventional tillage practices. The same experiment was also conducted at the Black Belt Branch Experiment Station near Brooksville, MS in 2013 also using conventional tillage practices. Three treatment factors were arranged in a factorial arrangement within a randomized complete block design with four replications. Factor A consisted of four planting dates of mid-April, mid-May, late-May and mid-June. Factor B consisted of varietal maturity and included DP 0912 B2RF (short-season) and DP 1252 B2RF (full season) (Monsanto Company, St. Louis, MO). Factor C consisted of PRE herbicide and included *S*-metolachlor (Dual Magnum; Syngenta Crop Protection, Greensboro, NC) at 1.07 kg ai ha^{-1} plus fluometuron (Cotoran 4L; ADAMA, Raleigh, NC) at 1.12 kg ai ha^{-1} and no PRE herbicide application. Soil texture at each location, cotton planting dates, PRE herbicide application dates, application equipment, and harvest dates varied across locations (Table 1). Rainfall events ranging from 11- to 134-cm occurred within seven days of PRE herbicide application in both years at all locations with the exception of rainfall following the mid-June planting date in Stoneville in 2013 and 2014. Mid-June planted cotton in Stoneville received rainfall within 10 days after PRE herbicide application in 2013 and 2014. Plots consisted of four 97 cm rows that were 12.2 m in length in Starkville and Brooksville and four 102 cm rows that were 12.2 m in length in Stoneville. Cotton seed of both varieties were treated with Acceleron N (metalaxyl at 0.014 mg a.i. per seed + pyraclostrobin at 0.04 mg a.i. per seed + ipconazole at 0.002 mg a.i. per seed + fluxapyroxad at 0.018 mg a.i. per seed + thiamethoxam at 0.375 mg a.i. per seed + abamectin at 0.15 mg a.i. per seed). Preemergence herbicides were applied at-planting with application volumes, pressure, and spray tips at all locations given in Table 1. Furrow irrigation was utilized as needed at the Starkville and Stoneville locations while Brooksville was managed with non-irrigated conditions. All plots were maintained weed free throughout the growing season using POST applied, non-residual herbicides. Plant growth regulators, fertilizer, and harvest aids were applied based on Mississippi State University Extension Service recommendations. No thrips insecticides were applied. Nitrogen was applied at 134 kg ha^{-1} in split-applications as 32% UAN with a ground driven knife applicator, at all locations in both years. The initial nitrogen application was made immediately following planting and the second application was made approximately 35 days after planting.

Table 1. Cotton planting and PRE herbicide application dates, application equipment, and harvest dates in 2013 – 2014

Environment	Soil Texture	Mid-April Planting Date†	Mid-May Planting Date†	Late-May Planting Date†	Mid-June Planting Date†	Application Equipment	Spray Tip Nozzles	Application Volume	Pressure	Harvest Date
								--- L ha^{-1} ---	--- kPa ---	
Brooksville	Brooksvile silty clay	N/A	20 May 2013	04 June 2013	17 June 2013	CO_2-pressurized backpack sprayer	1100015 TTI	140	317	29 October 2013
Starkville	Leeper silty clay loam	N/A	15 May 2013	31 May 2013	14 June 2013	Tractor-mounted compressed air sprayer	110015 AIXR	140	428	18 October 2013
			219 DD60s	455 DD60s	692 DD60s					
		23 April 2014	05 May 2014	22 May 2014	18 June 2014					19 October 2014
Stoneville	Bosket very fine sandy loam	N/A	15 May 2013	30 May 2013	17 June 2013	Tractor-mounted compressed air sprayer	8002 XR	140	255	30 October 2013
			257 DD60s	478 DD60s	764 DD60s					
		17 April 2014	08 May 2014	23 May 2014	12 June 2014					03 November 2014

†Planting dates with corresponding accumulative degree days at planting from 01 January of the corresponding year.

Data collection included the following: stand counts at 14 days after planting (DAP); cotton biomass at two-leaf growth stage; immature thrips infestation levels at two- and four-leaf stage; cotton height at four-leaf, pinhead square, and at first bloom growth stages; total nodes at first bloom, nodes above white flower (NAWF) at first bloom, cotton height, total nodes, and nodes above cracked boll (NACB) prior to harvest aid application and lint yield.

Cotton biomass at the two-leaf stage was collected from five randomly selected plants from each plot which were cut at the soil surface, placed into paper bags, and dried in a forced air dryer for 72 hours at 70°C. After drying, plants were weighed on an analytical balance to determine dry weight biomass. Thrips populations were sampled using the whole plant technique and washed using a technique modified from that of Burris et al. (1989; 1990). Five plants were selected randomly from each plot and clipped below the cotyledon leaves and quickly placed into self-sealing bags. The bags were transported to the laboratory and filled with a solution containing 10% bleach and soap. Cotton plants were allowed to soak in bleach and soap solution for 20 minutes. Plants were then washed over a standard No. 100 sieve. Thrips were separated from the sieve using an alcohol solution in a 500 ml squirt bottle onto nine-cm white filter paper marked with gridlines using a vacuum filtration system (Reisig et al., 2012). Filter paper was then placed into petri dishes from which thrips were separated based on color and counted using microscopy. Adult thrips that were dark in color were considered tobacco thrips while lighter colored adult thrips were considered other species. Stewart et al. (2013) observed 98% of thrips in MS were tobacco thrips. Immature thrips were marked “immature” due to inability to key to species. Plant heights were determined by measuring from the soil surface to the apical meristem. Total nodes were determined by counting the number of nodes on the main-stem. Nodes above white flower (NAWF) were determined by counting the number of nodes on the main-stem from the uppermost first position white flower to the apical meristem (Bourland et al. 1992). Nodes above cracked boll (NACB) were determined by counting the number of nodes from the uppermost first position cracked boll to the uppermost first position harvestable boll. The center two rows of each plot were harvested using a spindle-type cotton picker modified for small plot research. Lint yield for each plot was calculated from lint percent obtained from ginning seed cotton from each individual plot. Twenty five boll samples were collected prior to mechanical harvest and were subsequently ginned on a ten-saw laboratory gin (Continental Eagle). Data were subjected to analysis of variance (ANOVA) using the PROC MIXED procedure in SAS v.9.3 (SAS institute; Cary, NC). Means were separated using Fisher's Protected LSD ($\alpha \leq 0.05$). To examine potential interactions among treatment factors as well as site-year, four-way ANOVA for all variables including site-year were analyzed. No interaction including site-year was present. Therefore, site-year, replications, and replications nested within site-year were treated as a random effect (Blouin et al., 2011). Considering site-year as a random effect allows for treatment inferences over a range of environments (Blouin et al., 2011; Carmer et al., 1989). Degrees of freedom were calculated using the Kenward- Roger method.

RESULTS AND DISCUSSION

Stand counts collected 14 days after planting (DAP) were significantly affected by variety and planting date (Table 2). Stand counts collected 14 DAP were greater for DP 0912 B2RF at 109,421 plants ha^{-1} than for DP 1252 B2RF at 97,318 plants ha^{-1} (data not shown). These data are in agreement with Telenko and Donahoe (2014) who found greater plant populations of DP 0912 B2RF when seeded at equivalent rates compared to other early season cotton varieties. Stand counts at 14 DAP ranged from 87,932 to 111,891 plants ha^{-1}, regardless of planting date (Table 3). Stand counts at 14 DAP indicated that cotton seed planted in mid-May and after, resulted in greater plant populations compared to plant populations from the mid-April planting date (Table 3). These results are similar to those observed by Pettigrew and Meredith (2009) who observed cotton planted earlier in the growing season had reduced seedling emergence by 16% compared to a normal planting date due to colder weather. Pre-emergence herbicide application had no effect on stand counts. Reductions in cotton stand counts at 14 DAP have been observed when flumioxazin was applied at planting at 0.06 and 0.09 kg ha^{-1} (Berger et al., 2012). However, Price et al. (2004) reported minimal cotton injury following flumioxazin applied PRE.

Table 2. An analysis of variance p-values for thrips counts and cotton growth parameters as affected by variety, planting date, and PRE herbicide

Source	Stand Counts 14 DAP[a]	Cotton Biomass at 2 Leaf	Immature Thrips at 2 Leaf	Immature Thrips at 4 Leaf	Cotton Height at 4 Leaf	Cotton Height at Pinhead Square	Cotton Height at First Bloom	Nodes at First Bloom	NAWF[b]	Final Cotton Heights	Final Cotton Nodes	NACB[c]	Lint Yield
Variety	0.0011	<0.0001	0.2482	0.0722	0.0007	0.0538	<0.0001	<0.0001	0.7491	<0.0001	<0.0001	<0.0001	0.1845
Planting Date	0.0008	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0206	<0.0001	<0.0001	<0.0001	<0.0001
PRE herbicide	0.6115	0.0026	0.6322	0.1683	0.0461	<0.0001	0.9695	0.4793	0.1201	0.9188	0.1943	0.2863	0.0493
Variety x Planting Date	0.9185	0.0118	0.3711	0.1945	0.4815	0.1630	0.0006	0.1119	0.5199	<0.0001	0.6129	0.0002	0.0065
Variety x PRE herbicide	0.4614	0.9582	0.9629	0.8583	0.2211	0.1949	0.4038	0.5778	0.4369	0.1787	0.4164	0.6359	0.7911
Planting Date x PRE Herbicide	0.6378	0.1170	0.8812	0.9188	0.3696	0.2462	0.1646	0.5333	0.2383	0.0502	0.2532	0.7925	0.3997
Variety x Planting Date x PRE herbicide	0.0866	0.9615	0.6626	0.9299	0.4640	0.8086	0.1831	0.3784	0.5306	0.1010	0.9157	0.5842	0.5360

[z] **Days after planting.**

[y] **Nodes above white flower.**

[x] **Nodes above cracked boll.**

Table 3. Stand counts 14 days after planting, cotton height at pinhead square, immature thrips counts at the 2- and 4-leaf stage, and nodes above white flower as affected by planting date[zy]

Planting Date	Stand Count at 14 DAP[x]	Immature Thrips at 2 leaf	Immature Thrips at 4 leaf	Cotton Height at Pinhead Square	NAWF[w]
	----- plants ha^{-1} -----	---------------------- #	----------------------	---------- cm ----------	--------- # ---------
Mid-April	87,932 b	3 d	44 c	33 c	8.1 a
Mid-May	108,433 a	22 c	85 b	31 d	7.6 b
Late-May	105,222 a	76 a	225 a	36 b	8.1 a
Mid-June	111,891 a	35 b	54 c	37 a	7.7 b

[z] Data were pooled over variety and PRE herbicides as no interactions were observed.

[y] Means within a column followed by the same letter are not significantly different based on Fisher's protected LSD at $p \leq 0.05$.

[x] Days after planting.

[w] Nodes above white flower.

An interaction between planting date and variety was observed for cotton biomass collected at the two-leaf growth stage (Table 2). In addition, PRE herbicide application had a significant effect on cotton biomass collected at the two-leaf growth stage. There was no difference in biomass at the two-leaf stage between DP 0912 B2RF and DP 1252 B2RF planted in mid-April and mid-May (Figure 1). However, DP 0912 B2RF had significantly greater biomass at the two-leaf stage than DP 1252 B2RF when planted in late-May and mid-June (Figure 1). Cotton to which no PRE was applied had significantly greater biomass at the two-leaf stage regardless of variety or planting date (Figure 2). Previous research has shown that PRE herbicides can reduce cotton biomass at the one- and two-leaf growth stages (Hayes et al., 1981). Askew et al. (2002) reported PRE herbicide application resulted in up to 12% biomass reduction in cotton two weeks after planting.

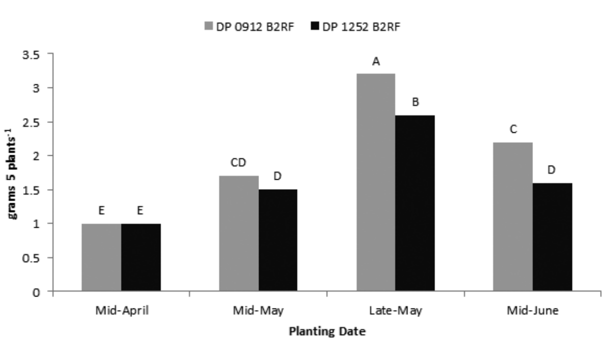

Figure 1. Cotton biomass at the 2-leaf stage as affected by planting date and variety.

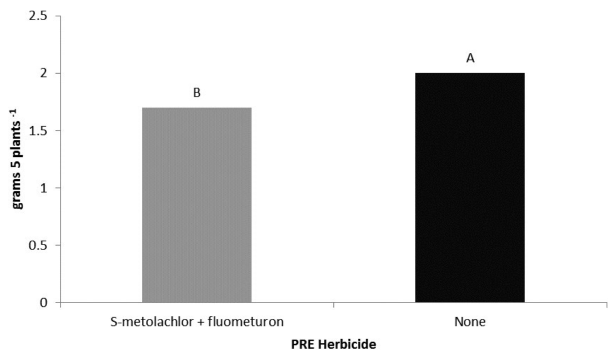

Figure 2. Cotton biomass at the 2-leaf stage as affected by PRE herbicide.

Variety and PRE herbicide application did not have an effect on immature thrips counts nor were any significant interactions thereof observed. Planting date significantly impacted immature thrips counts collected at the two- and four-leaf growth stages (Table 2). Immature thrips counts ranged from 3 to 76 thrips per five plants at the two-leaf growth stage and from 44 to 225 thrips per five plants at the four-leaf growth stage. Cotton planted in late-May had significantly more immature thrips at both the two- and four-leaf growth stages compared to all other planting dates (Table 3). In addition, the least number of immature thrips were collected from two- and four-leaf cotton planted in mid-April. Furthermore, similar numbers of immature thrips were observed on four-leaf cotton from the mid-April and mid-June planting dates (Table 3). These findings are similar to Morsello et al. (2008) who observed that thrips populations peaked in mid-May and prior to May 31 in North Carolina and Virginia. In addition, Reitz (2002) observed that immature thrips numbers peaked in early May on tomatoes in Florida. Cook et al. (2011) reported that thrips numbers and visual damage ratings in cotton peaked in May, which could be due to destruction of overwintering habitats and thrips moving to host row crops such as cotton.

Table 4. Nodes above cracked boll and lint yield as affected by variety and planting date[zy]

Variety	Planting Date	NACB[x]	Lint Yield
		------ # ------	--- kg ha^{-1} ---
DP 0912 B2RF	Mid-April	1.9 d	2294 abc
	Mid-May	2.0 d	2238 ab
	Late-May	4.9 b	2195 bc
	Mid-June	--	1494 d
DP 1252 B2RF	Mid-April	2.4 d	2352 ab
	Mid-May	3.8 c	2429 a
	Late-May	6.2 a	2137 c
	Mid-June	--	1166 e

[z] Data were pooled across PRE herbicide as no interactions were observed.

[y] Means within a column followed by the same letter are not significantly different based on Fisher's protected LSD at p≤0.05.

[x] Nodes above cracked boll.

--NACB not present at the time of harvest aid application.

There were no interactions between variety, planting date, and PRE herbicide application for cotton height at the four-leaf stage (Table 2). However, the main effects of each were significant for cotton height at the four-leaf stage. Height of DP 0912 B2RF at the four-leaf growth stage was significantly greater (21 cm) compared to DP 1252 B2RF (20 cm) (Figure 3A). Cotton height at the four-leaf growth stage ranged from 16 to 27 cm depending on planting date. Cotton planted in mid-June was significantly taller at the four-leaf stage than cotton at the four-leaf stage at all other planting dates (Figure 3B). Cotton planted in mid-May was significantly shorter at the four-leaf stage than cotton at the four-leaf stage from all other planting dates. At the four-leaf growth stage, cotton planted in mid-April was significantly shorter than cotton planted in late-May and mid-June but significantly taller than cotton planted in mid-May. Similarly, Wumbei (2014) reported that later planted cotton was taller than earlier planted cotton during the flowering stage. Cotton that did not receive a PRE herbicide treatment was significantly taller at the two- and four-leaf stage than cotton treated with *S*-metolachlor + fluometuron (Figure 3C). These results agree with previous data showing some pre-emergence herbicides may stunt early season cotton growth by up to 15% (Main et al., 2012). In addition, differences in maturity between varieties can also contribute to height differences (Wumbei,, 2014).

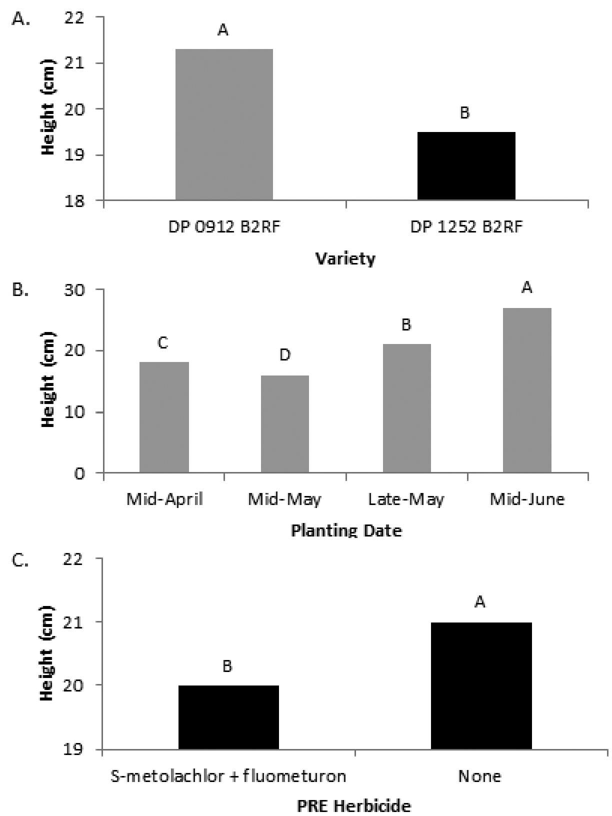

Figure 3. Cotton height at the 4-leaf stage as affected by variety (A.), planting date (B.), and PRE herbicide (C.).

Cotton height at pinhead square was affected by planting date and PRE herbicide; however, no interactions thereof were observed (Table 2). Cotton height at pinhead square ranged from 31 to 37 cm, depending on planting date. Cotton planted in mid-June was significantly taller at pinhead square than cotton at pinhead square from all other planting dates (Table 3). Cotton not treated with a PRE herbicide was significantly taller than cotton treated with *S*-metolachlor +fluometuron at pinhead square (data not shown).

A variety by planting date interaction was present for cotton height at first bloom (Table 2). Cotton height at first bloom ranged from 68 to 90 cm. DP 1252 B2RF was taller than DP 0912 B2RF at first bloom regardless of planting date (Figure 4). Cotton height at first bloom was greater when

DP 1252 B2RF was planted in mid-June when compared to cotton height of both varieties at first bloom in all other planting dates (Figure 4). DP 1252 B2RF was significantly taller when planted in mid-April compared to the mid-May planting date; however, DP 0912 B2RF planted in mid-April and mid-May produced similar heights at first bloom (Figure 4).

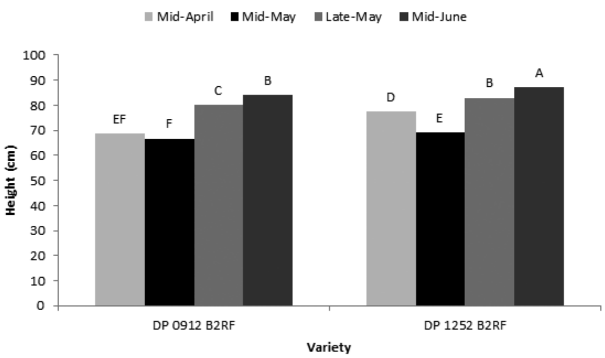

Figure 4. Cotton height at first bloom as affected by variety and planting date.

Total nodes at first bloom was affected by variety and planting date; however, no interactions between variety and planting date were observed (Table 2). DP 0912 B2RF produced significantly more total nodes (13.9) than DP 1252 B2RF (13.6) at first bloom (Figure 5). Cotton planted in late-May produced significantly more total nodes (14.2) than all other planting dates for both varieties (Figure 5). However, total nodes at first bloom were similar when cotton was planted in mid-April (14) and mid-June (14); however, significantly less total nodes were present when cotton was planted in mid-May (12.9) (Figure 5).

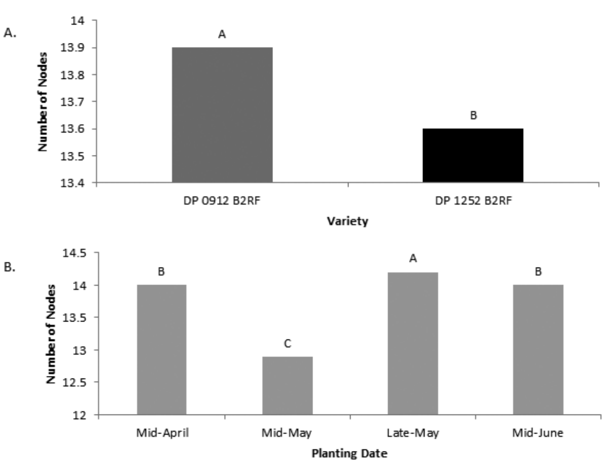

Figure 5. Total nodes at first bloom as affected by variety (A) and planting date (B) pooled over PRE herbicide.

Planting date affected NAWF at first bloom which ranged from 7.6 to 8.1 (Table 2). Cotton planted in mid-April and late-May had greater NAWF counts than cotton planted in mid-May or mid-June (Table 3). Under normal growing conditions, nine to ten NAWF at first bloom is optimal (Silvertooth, 1994). Lower NAWF counts at first bloom indicate stress from growing conditions while higher NAWF at first bloom could be due to excess nitrogen or poor fruit retention (Silvertooth, 1994).

Final cotton height was affected by an interaction between variety and planting date (Table 2). Height of DP 1252 B2RF was greater than DP 0912 B2RF at the end of the season regardless of planting date (Figure 6). Final cotton height was similar when DP 0912 B2RF was planted in mid-April (97 cm) and mid-May (96 cm); however, DP 0912 B2RF was significantly taller when planted in late-May (107 cm) and mid-June (108 cm) (Figure 6). No differences in final cotton height were observed when DP 0912 B2RF was planted in late-May and mid-June (Figure 6). Final cotton height was significantly greater when DP 1252 B2RF was planted in mid-June (126 cm) compared to all other planting dates (Figure 6). However, final cotton heights were similar when DP 1252 B2RF was planted in mid-April (116 cm) and late-May (118 cm) (Figure 6). Final cotton heights were similar when DP 1252 B2RF was planted in mid-April and mid-May (114 cm); however, cotton planted in mid-May was significantly shorter at harvest when compared to the same variety planted in late-May and mid-June (Figure 6).

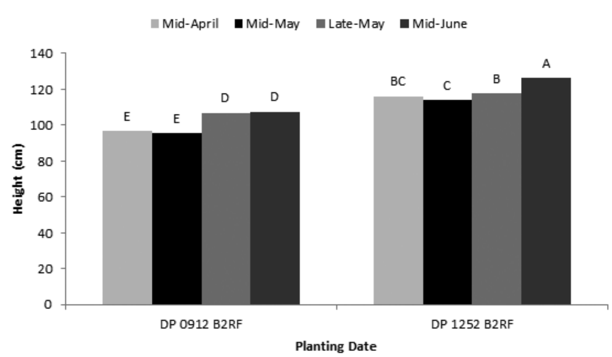

Figure 6. Final cotton height as affected by variety and plant date.

Final cotton nodes were affected by variety and planting date; however no interactions thereof were observed (Table 2). DP 1252 B2RF produced significantly more nodes (17.8) than DP 0912 B2RF (17) at harvest (Figure 7). Cotton planted in mid-

June produced similar nodes (17.8) at harvest when compared to cotton planted in mid-April (17.5) (Figure 7). Additionally, cotton planted in mid-June produced significantly more nodes than cotton planted mid-May (17) and late-May (17.2) (Figure 7). No differences in final cotton nodes were observed when cotton was planted in mid-April compared to cotton planted in late-May (Figure 7). However, cotton planted in mid-April produced significantly more nodes than cotton planted in mid-May (Figure 7). Similar final cotton nodes were observed between cotton planted in mid- and late-May (Figure 7).

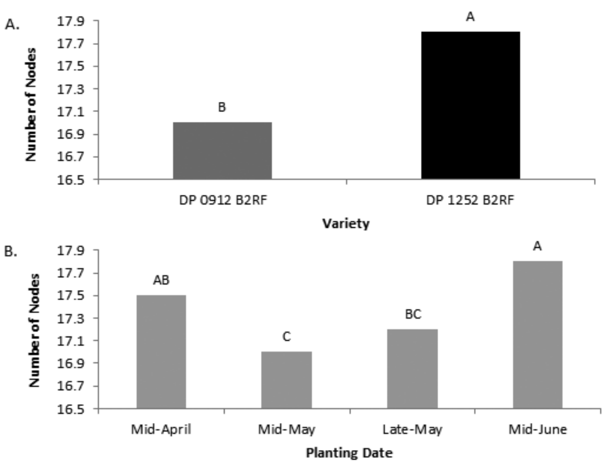

Figure 7. Final cotton nodes as affected by variety (A) and planting date (B).

Nodes above cracked boll (NACB) is an indicator of plant maturity (Bynum and Cothren, 2008). Higher NACB counts represent a less mature plant whereas a lower NACB count indicates a more mature plant. There was a significant interaction between variety and planting date for NACB (Table 2). There were no significant differences in NACB among varieties planted in mid-April (Table 4). DP 1252 B2RF planted in mid-May and late-May was less mature than DP 0912 B2RF at the end of the season. Differences in NACB are likely a result of DP 0912 B2RF being an early maturing variety while DP 1252 B2RF being a full season variety. In addition, maturity of both DP 0912 B2RF and DP 1252 B2RF was delayed as NACB counts increased as planting dates became later.

An interaction between variety and planting date was observed for lint yield (Table 2). DP 1252 B2RF and DP 0912 B2RF planted in mid-April and mid-May yielded significantly greater than the same varieties planted in mid-June (Table 4). In addition, DP 1252 B2RF planted in mid-April and mid-May yielded significantly greater than the same variety planted in late May. These data agree with Davidonis et al. (2004), who reported that lint yields for cotton planted early in the growing season were significantly greater than lint yields of cotton planted at later planting dates. However, DP 1252 B2RF produced less lint yield when compared to DP 0912 B2RF when planted mid-June (Table 4). In addition, maturity of DP 1252 B2RF was significantly delayed compared to DP 0912 B2RF when planting dates became later (Table 4.). Harvest aids were applied uniformly across each trial and harvest occurred on the same date for each trial, regardless of planting date. Observed yield differences are due, at least in part, to differences in cotton maturity due to planting date. As planting dates become later, full season varieties will likely experience a delay in maturity and produce less lint yield as opposed to a short-season variety. Preemergence herbicide had a significant effect on cotton lint yield (Table 2). Cotton that did not receive PRE herbicide treatment produced 100 kg ha^{-1} more lint yield than cotton treated with *S*-metolachlor + fluometuron, regardless of planting date or variety (Figure 8). Main et al. (2012) reported 23 to 25% yield reduction when fomesafen was applied preemergence.

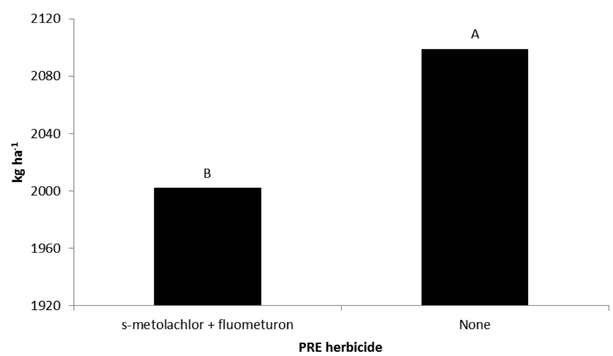

Figure 8. Cotton lint yield as affected by PRE herbicide.

These data are in agreement with previous experiments in that variety, planting date, and PRE herbicide can impact growth parameters of cotton. Preemergence herbicides are recommended for all cotton production systems due to glyphosate-resistant weeds and other difficult to control weed species. Although yields were decreased by PRE herbicide application, the benefit of PRE herbicides in areas where glyphosate-resistant weeds are present cannot be overstated. The presence of troublesome, competitive weeds can disrupt early season cotton growth and decrease yield potential. Also, early planting in conjunction with the appropriate variety, can positively affect yields. Both early- and late-maturing varieties planted in mid-April and mid-May will maximize yields. However, planting a later maturing variety later in the season can result in reduced yield. An early-maturing variety planted at a later planting date will produce a more vigorous, earlier crop, and higher yields compared to later maturing varieties planted at later planting dates.

Growers are encouraged to select a variety with the greatest yield potential for their particular situation. However, if planting is delayed growers should consider planting a shorter season variety to maximize potential yield. In addition, growers should be more vigilant with respect to thrips management if cotton is planted in mid- to late-May in the Mid-South, regardless of variety or PRE herbicide application.

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