EFFECTS OF MEPIQUAT REGIMES ON FIBER LENGTH AND UNIFORMITY

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Introduction

In recent years concerns have been expressed about fiber quality of Georgia cotton, specifically about the quality measure of fiber length uniformity or length uniformity ratio. The uniformity ratio measures the variation in the length of fibers within a bale and indirectly reflects short fiber content, a term referring to fibers less than 0.5 inch in length and reportedly, as short fiber content exceeds 8 percent, spinning efficiency of cotton yarn decreases dramatically.

The plant growth regulator mepiquat chloride (MC) has been used in cotton for almost 30 years to reduce canopy height, encourage rapid, early fruit set, and shorten the overall fruiting cycle.

Three irrigated studies involving varying MC programs were conducted to explore the effects of PGR applications on fiber length and fiber length uniformity. The first experiment included the use of MC to attempt to compact the fruiting period of two varieties that represent the broad range of maturity, from a very determinant (DP 444 BG/RR) to the most indeterminant (DP 555 BG/RR). The second explored the effects of the time of initiation of MC treatments and the third included the potential effects of misapplication of the new PGR Stance compared to standard treatments.

Materials and Methods

'DP 555 BG/RR' and 'DP 444 BG/RR' were planted on May 3, 2006, at the Lang Farm near Tifton, GA. MC regimes were imposed to seek (a) to compact the fruiting cycle or (b) to allow a more extended fruiting period.

'DP 555 BG/RR' was planted on May 3, 2006, at the Lang Farm near Tifton, GA. Treatments included the initiation of a three-application regime of MC at pinhead square, 10 days later, or at first bloom.

'DP 555 BG/RR' was planted on May 3, 2006, at the Lang Farm near Tifton, GA, and on May 5, 2006, at the Sun Belt Ag Expo near Moultrie, GA. Treatments included a standard MC program (8 oz/A applied three times), a Stance program (3 oz/A applied three times), and a Stance program with excessive rates (8 oz/A applied three times). Application times were match head square, 1st bloom, and 2 weeks after 1st bloom.

For each study, plot size was 4 or 6 rows (36 inch rows) by 40 feet and there were 4 replications. Treatments were applied with a high clearance small plot sprayer or a backpack sprayer. Plots were harvested on September 21 at Tifton and on September 28 at Moultrie. Machine-harvested samples from the center rows of each plot were processed at the UGA Cotton Micro Gin and associated fiber samples were analyzed by Star Labs in Knoxville, TN. Fiber length (staple or upper half mean length) and fiber length uniformity data are reported.

Results and Discussion

Efforts to compact the fruiting period with MC were frustrated by extremely hot, dry conditions and a week and a half break down of irrigation equipment during early to mid-bloom. As a result there was little separation among treatments for duration of fruiting period as indicated by nodes above white flower counts beginning at 1st bloom (data not shown). Differences in final plant height were achieved (Table 1). DP 555 BG/RR produced significantly greater yield and fiber length (upper half mean length or staple) than DP 444 BG/RR, while as expected the reverse was true for uniformity. MC regime did not affect yield or these measures of fiber length.

Time of initiation of MC programs on DP 555 BG/RR influenced final plant height but had little to no impact on yield or fiber length and uniformity (Table 2).

Standard applications of MC and Stance resulted in a significant reduction in plant height compared to the untreated control, while the excessive rate of Stance caused a further reduction in height (Table 3). Yields were not affected by any treatment at Tifton but the excessive rate of Stance reduced yields at Sun Belt. Stance resulted in greater fiber length compared to the untreated control and MC. Stance-treated cotton had higher uniformity than the untreated control at both locations.

Table 1. Effect of Fruiting Period Compaction on Final Plant Height, Yield, Fiber Length, and Fiber Length Uniformity, Lang Farm, 2006.

Variety	MC Program	Height, in	Lint, lb/A	Length, in	Uniformity
DP 444 BG/RR	Aggressive	31.0	1378.5	1.125	82.6
DP 444 BG/RR	Minimal	35.1	1382.0	1.118	82.6
DP 555 BG/RR	Aggressive	31.9	1837.3	1.138	81.6
DP 555 BG/RR	Minimal	35.6	1777.7	1.136	81.8
	LSD (0.10)	3.5	192.1	0.017	0.3

Programs for DP 444 BG/RR were: Aggressive - 16 oz/A at pinhead square and 1st bloom; Minimal - 8 oz/A at 1st flower.
Programs for DP 555 BG/RR were: Aggressive - 16 oz/A at pinhead square followed by 24 oz/A 10 and 25 days later; Minimal - 8 oz/A at pinhead square and 1st flower.

Table 2. Effects of the Time of Initiation of MC Treatments on Final Plant Height, Yield, Fiber Length, and Fiber Length Uniformity, Lang Farm, 2006.				
MC Treatment	Height, in	Lint, lb/A	Length, in	Uniformity
None	39.7	1850.9	1.145	82.1
12 oz PHS 12 oz PHS+10d 12 oz PHS+20d	30.0	1814.3	1.155	81.9
12 oz PHS+10d 12 oz PHS+20d 12 oz PHS+30d	33.15	1943.1	1.147	82.0
12 oz 1st Blm 12 oz 1st Blm+10d 12 oz 1st Blm+20d	35.7	1861.3	1.157	82.3
LSD (0.10)	2.5	103.6	0.007	0.6

Table 3. Effects of High Rates of Stance Compared to Standard Rates of MC and Stance, Lang Farm and Sun Belt Expo, 2006.				
MC Treatment	Height, in	Lint, lb/A	Length, in	Uniformity
Tifton, Lang Farm				
None	38.2	1768.1	1.122	82.0
MC 8 oz	29.9	1789.6	1.137	82.1
Stance 3 oz	29.2	1730.7	1.160	82.3
Stance 8 oz	26.6	1689.9	1.187	82.7
LSD (0.10)	1.0	121.8	0.010	0.2
Moultrie, Sun Belt Expo				
None	48.2	1895.4	1.113	80.3
MC 8 oz	34.9	1874.3	1.127	80.9
Stance 3 oz	36.2	2033.2	1.139	80.9
Stance 8 oz	31.6	1624.3	1.160	81.2
LSD (0.10)	2.6	182.9	0.013	0.6
Applications made at match head square, 1st bloom, and 2 weeks after 1st bloom.				

BREEDING GEORGIA-ADAPTED COTTON GERMPLASM AND CULTIVARS WITH EMPHASIS ON ROOT-KNOT NEMATODE (RKN) RESISTANCE

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Introduction

Poor profit potential of cotton production from yield stagnation and high pest management costs impels creation of cultivars with inherent genetic resistance to enhance economic returns for Georgia cotton producers. Insect, nematode, and weed pest management costs are among the highest expenditures growers face in cotton production (National Cotton Council, 2001), thus their reduction would enhance profitability of cotton production.

Surveys of the densities of root-knot nematodes (*Meloidogyne incognita,* RKN) reveal that the major cotton-producing counties in Georgia have damaging levels of root-knot nematodes (National Cotton Council, 1998). It is estimated that Georgia producers lose about 77,000 bales of cotton annually from RKN damage (Blasingame and Petal, 2001). Crop rotation, while a recommended cultural practice to lessen soil populations of RKN, is not an option for most Georgia growers because of the lack of suitable non-host crops with which to rotate their cotton acreages. Therefore, inherent genetic resistance provides an attractive alternative to pesticides and crop rotation.

Despite the widespread occurrence of RKN in most cotton production areas in the Southeast and that genetic resistance to RKN has existed since 1974 (Shepherd, 1974), private cultivar developers have exhibited little interest in fulfilling this need. Commonly cited reasons for the slow progress in developing RKN resistant cultivars is that the current screening process is costly, tedious, time consuming and destructive for identifying resistance genotypes. Further, most breeding stations neither have the facilities nor personnel with expertise in nematology to carry out the screening process to identify resistant material. Of those RKN-resistant (CPCSD Acala NemX) or tolerant cultivars (ST LA887 or PM H1560) that have been distributed by commercial cotton seed companies, none are adapted to the Southeast. Cotton cultivars adapted for the unique aspects of the Georgian environment, such as rainfall patterns, soils types and depth, and *presence of root-knot nematodes* must be developed to give the best available genetics to the GA producer.

Public breeders have historically been the pre-breeders; doing the challenging work of developing new acceptable parents that can then be directly used to make improved cultivars. Because the recent shift to patenting cultivars will slow the industry's overall development of enhanced cultivars, the seed companies will place a higher priority on the ongoing renewal of their gene pools as well as trying to locate other sources of adapted germplasm. In this seller's market, publicly released germplasm lines should have the leverage to ensure that the better adapted material developed by a state gets to that state's cotton farmer.

Taken as a whole, a UGA cotton breeding program with continuity provides the foundation to ensure that traits needed by the Georgia cotton growers such as increased yield and enhanced fiber quality in cultivars that are adapted to Georgia production conditions would not be overlooked. Specifically, the objective to develop Georgia-adapted cotton germplasm with RKN resistance will benefit the state's producers by providing increased yield and decreased production costs whereas the increased availability of RKN-resistant germplasm will benefit the cotton industry across the belt.

Materials and Methods

Drs. Chee, May, and Davis developed advanced RKN resistant parents from a backcross breeding population using M120RNR and M155RNR RKN resistant donor parent with the elite breeding line PD94042 (May, 1999).

Results and Discussion

RKN resistant BC3F3 lines have been further selected during the first quarter of 2006 in a 10 plant sub-sample that was inoculated twice with a very high rate of nematodes and evaluated for galling. About 1 out of 6 plants had near immunity just like M-120. Further field testing in 2006 rigorously selected 25 out of 176 entries which are being verified with additional testing in the greenhouse. Unfortunately, the growth of the RKN cotton population in the greenhouse was delayed due to some equipment problems that ended up keeping the greenhouse slightly cooler than desired. This led to a holdup in planting the 176 entry test in Dr. Davis' RKN infested field which, in turn, affected the nicking of the planned crossing in July to GA breeding lines. However, this missed crossing opportunity had an unexpected benefit since additional information from the 2006 yield tests indicated better parental selections than what we would have used in the summer. To ensure that the better yielding, value-added GA lines nicked with the RKN resistant parents, these parents were planted after harvest in the greenhouse.

We are planning to use the most up-to-date molecular markers from a companion project (Shen et al., 2006) in a three-cycle backcrossing program to insert the RKN resistance gene during 2007. We believe this approach should provide a more reliable insertion of the RKN resistance gene and, thereby, a more trustworthy release of the germplasm/cultivars. The chromosomal region bearing the RKN resistance that is indicated by these molecular markers has also been already verified independently (Ynturi et al., 2006), although our work appears to have markers that are, at present, closer to the RKN resistance gene. Our lab has also already found in some preliminary fingerprinting that the markers appear polymorphic between the Georgia lines and both parents of the RKN resistance donors. We plan to complete the backcrossing by the end of autumn 2007 so we can send the BC_2 population to the winter nursery in Mexico to obtain seed for the 2008 growing season. In the summer of 2008, we intend to plant an unreplicated modified augmented design yield test (with every 5th row in the trial assigned to a conventional check cultivar) in either Tifton or Plains to select for yield and to verify the homozygosity of the RKN resistance marker(s). The trial will be machine harvested and the seed-cotton yield of each F4 progeny row compared with seed-cotton yield of the nearest check row.

We will harvest boll samples for lint %, fiber quality, and for seed in a parallel increase field for the rows that significantly out-yield the nearest check plot. The preliminary trial (PT), which is the next step, will be conducted near Tifton or Plains, GA, depending upon land availability. Advanced generation germplasm lines promoted from the PT shall be tested in an Advanced yield trial (AT) in Plains and Tifton. Elite germplasm lines from a successful performance in the ATs will be tested in locations throughout the state in both dryland and irrigated fields in the University of Georgia Official Variety Trials. This approach should quickly provide a solid performing release of RKN resistant germplasm/cultivars.

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