THRIPS RESISTANCE AND FIELD PERFORMANCE OF ADVANCED COTTON BREEDING LINES AND CULTIVARS UNDER ORGANIC MANAGEMENT

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Abstract

Thrips management is more problematic in organic systems where synthetic pesticide applications are prohibited. Additionally, organic growers are in need of commercial, non-transgenic cotton varieties that are adapted for the Texas High Plains. Twelve advanced cotton breeding lines and 4 cultivars were evaluated in an organically-managed field experiment to evaluate lines for field thrips resistance and other agronomic characteristics. There were a number of differences for each parameter among genotypes and all breeding lines performed well compared to the commercial standards. However, breeding line 07-7-1407CT appeared to exhibit an excellent combination of thrips resistance and field performance and could be viable option for commercial organic production or for use as a parent line.

Introduction

In the absence of synthetic pesticide applications, thrips (Thysanoptera: Thripidae) management can be more problematic in organic production systems than conventional cotton systems. Additionally, nearly all organic cotton acreage on the Texas High Plains (THP) is planted with one or two conventional cultivars and seed-saving is near-ubiquitous, as these cultivars are no longer commercially-available. Development of new thrips-resistant, non-transgenic cultivars has the potential to greatly improve the availability and diversity of viable cultivars and overall production of organic cotton on the THP.

Materials and Methods

Seven advanced breeding lines (developed by the Texas A&M Cotton Improvement Program at Lubbock), 2 formerly-commercial cultivars, and 1 newly-released germplasm line (developed by the Texas A&M Cotton Improvement Program at College Station) were planted on certified organic land near Meadow, TX in 2011. The experiment was expanded in 2012 to include 4 additional breeding lines, another formerly-commercial cultivar, and a new cultivar, all planted at the Texas A&M AgriLife Research and Extension Center at Lubbock. The 2012 location was not certified organic, but was managed according to organic production guidelines. Thrips resistance was assessed using early-season visual injury ratings (at the 4^{th}-5^{th} true leaf stage). Late-season visual leaf pubescence ratings were also conducted in 2012, to address the heightened impact of leaf pubescence on leaf grade in organic systems, where growers rely solely on the first killing freeze for defoliation. Yield and HVI fiber quality data were collected both years for each genotype.

Results and Discussion

Due to extreme drought conditions in 2011, thrips pressure was too low to observe any plant damage, so visual ratings were conducted only in 2012. Lines 06-45-1104D, 07-7-519CT, 07-7-1001CT, 07-7-1020CT, 07-7-1303CT, and 07-7-1407CT exhibited among the highest levels of resistance to thrips injury in this experiment (Table 1). The "CT" notation indicates that these lines were originally selected for early-season cold tolerance. Because thrips are only a pest of seedling cotton, early-season selection could have also simultaneously selected for thrips resistance. Similarly, the CT lines have characteristically thick, leathery leaves, which could aid in conferring greater tolerance to thrips feeding injury.

Table 1. Visual thrips ratings, storm ratings, pubescence ratings, and lint yield of 12 advanced cotton breeding lines and 4 cultivars under organic management near Meadow and Lubbock, TX in 2011 and 2012.

Genotype	Thrips Ratings[a]	Storm Rating[b]		Pubescence Ratings[c]	Lint Yield	
	2012	2011	2012	2012	2011	2012
					------kg ha^{-1}-----	
06-21-519FQ	4.4 cd	5.3 ab	4.0 d-f	3.0 d-g	966 a	1140 a
06-45-1104D	6.3 ab	5.8 ab	4.3 c-f	4.7 bc	995 a	972 a
07-7-519CT	6.1 a-c	---	6.0 ab	3.5 c-e	---	1125 a
07-7-1001CT	7.0 a	5.0 bc	5.0 a-e	6.7 a	968 a	1207 a
07-7-1020CT	6.7 a	---	6.0 ab	3.3 c-f	---	1157 a
07-7-1303CT	6.3 ab	---	4.3 c-f	4.3 b-d	---	1096 a
07-7-1407CT	6.3 ab	5.3 ab	5.7 a-c	3.3 c-f	983 a	928 a
07-14-205FS	3.7 d	5.5 ab	3.7 ef	5.0 b	1124 a	942 a
07-14-510FS	4.0 d	5.3 ab	6.3 a	4.7 bc	1083 a	1132 a
07-20-1304D	5.0 b-d	6.0 a	5.3 a-d	4.3 b-d	1094 a	1182 a
09T#1-1116-FQ	5.0 b-d	---	5.0 a-e	2.0 fg	---	1054 a
TAM 04WB-33s	3.7 d	4.3 c	3.3 f	1.7 g	1089 a	1013 a
All-Tex® Atlas	3.7 d	---	4.7 b-f	2.3 e-g	---	1069 a
FiberMax® FM 958	5.7 a-c	6.0 a	5.0 a-e	3.0 d-g	977 a	1194 a
FiberMax® FM 989	6.0 a-c	5.0 bc	3.7 ef	2.3 e-g	1076 a	1238 a
Tamcot 73	4.3 cd	---	4.0 d-f	5.7 ab	---	1312 a

Means within a column followed by the same letter are not significantly different according to multiple pairwise t-tests at P = 0.05.
[a] Based on 1-9 visual rating scale; "1" = plant necrosis and "9" = no observable damage.
[b] Based on 1-9 visual rating scale; "1" = extremely loose boll structure and "9" = extremely tight boll structure.
[c] Based on 1-9 visual rating scale; "1" = glabrous and "9" = extremely pilose.

Storm ratings varied more in 2012 than 2011 (Table 1). In 2011, all breeding lines (excluding 07-7-1001CT and TAM 04WB-33s) had storm ratings that were not significantly different than FM 958, the current commercial standard. Lines 07-7-519CT, 07-7-1020CT, 07-7-1407CT, and 07-14-510FS exhibited among the highest storm ratings in 2012. TAM 04WB-33s exhibited a very low storm rating both years and would thus be a poor choice for organic growers on the THP. Line 07-7-1303CT and Tamcot 73 were the two most pilose genotypes in this experiment (Table 1) and would be problematic for organic production, given the detrimental effect of pubescence on leaf grade. Line 09T#1-1116-FQ and TAM 04WB-33s were the two most glabrous genotypes, although a number of other genotypes were only minimally pubescent.

Lint yields ranged from 966 to 1124 kg ha^{-1} in 2011 and 928 to 1312 kg ha^{-1} in 2012 (Table 1). There were no significant differences among genotypes, indicating that the breeding lines evaluated in this experiment were comparable to the commercial standards.

There were also a number of differences in various HVI fiber quality parameters (Table 2), although nearly all of the entries in this experiment had desirable fiber quality. There were no significant micronaire differences in 2011, though none of the values fell in a discount category. In 2012, almost all genotypes had micronaire values that fell within a range that would also not be discounted. However, 07-7-1407CT was the only genotype with a micronaire value that would be discounted in 2012 (2.9). Lines 07-14-205FS and TAM 04WB-33s consistently exhibited the greatest fiber length among genotypes both years. In 2011, TAM 04WB-33s also exhibited the greatest length uniformity, along with FM 989. There were no significant uniformity differences in 2012. All entries exhibited bundle strength values that would fall in a premium category, but 07-14-205FS, TAM 04WB-33s, and FM 989 had the greatest strength among genotypes over the two years.

Table 2. HVI fiber quality results for 12 advanced cotton breeding lines and 4 cultivars under organic management near Meadow and Lubbock, TX in 2011 and 2012.

Entry	Micronaire		Length		Uniformity		Strength	
	2011	2012	2011	2012	2011	2012	2011	2012
			----------in----------		----------%----------		----------g tex^{-1}---------	
06-21-519FQ	3.8 a	4.0 a-c	1.13 d	1.17 c	82.8 b	81.8 a	33.9 cd	31.3 e-g
06-45-1104D	4.1 a	3.5 d	1.16 bc	1.18 bc	82.7 b	82.6 a	34.2 b-d	31.4 d-g
07-7-519CT	---	3.8 b-d	---	1.16 c	---	82.8 a	---	31.1 fg
07-7-1001CT	4.6 a	3.8 b-d	1.07 f	1.08 e	82.2 bc	82.4 a	30.7 f	30.9 g
07-7-1020CT	---	3.7 b-d	---	1.14 cd	---	82.5 a	---	31.9 d-g
07-7-1303CT	---	4.1 ab	---	1.18 bc	---	81.9 a	---	33.0 c-e
07-7-1407CT	3.7 a	2.9 e	1.11 e	1.17 c	81.4 c	82.1 a	32.5 e	32.8 c-f
07-14-205FS	3.8 a	3.6 cd	1.17 b	1.27 a	82.9 b	84.2 a	34.9 bc	36.9 a
07-14-510FS	4.5 a	3.5 d	1.13 d	1.19 bc	81.9 bc	81.7 a	31.0 f	33.1 cd
07-20-1304D	3.8 a	4.0 a-c	1.16 bc	1.14 cd	81.8 bc	82.4 a	33.2 de	31.4 d-g
09T#1-1116-FQ	---	3.9 a-d	---	1.19 bc	---	81.5 a	---	33.9 bc
TAM 04WB-33s	4.1 a	3.6 cd	1.24 a	1.23 ab	85.2 a	82.9 a	35.6 b	35.1 ab
All-Tex® Atlas	---	4.3 a	---	1.10 de	---	82.7 a	---	32.5 c-g
FiberMax® FM 958	4.4 a	4.1 ab	1.14 cd	1.17 c	82.0 bc	83.2 a	32.5 e	31.8 d-g
FiberMax® FM 989	4.1 a	3.9 a-d	1.17 b	1.15 cd	84.8 a	82.1 a	38.2 a	31.6 d-g
Tamcot 73	---	3.5 d	---	1.16 c	---	82.8 a	---	34.1 bc

Means within a column followed by the same letter are not significantly different according to multiple pairwise t-tests at P = 0.05.

Conclusions

Based on the many parameters evaluated in this experiment, 07-7-1407CT appeared to contain an excellent combination of valuable characteristics among genotypes. The line exhibited a desirable combination of resistance to thrips injury, minimal pubescence, and yield and fiber quality potential that was comparable to the commercial controls. It did not exhibit exceptional HVI fiber quality compared to the other entries, but would still be commercially acceptable. Line 07-7-1407CT would likely be a viable cultivar option for organic growers and/or an excellent parent line for future cultivar development.

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