2013 Field Evaluations for *Organic* Cotton Production

Technical Report
14-2

Texas A&M AgriLife Research / Craig Nessler, Director
The Texas A&M System / College Station, Texas

TEXAS A&M AGRILIFE EXTENSION

TEXAS A&M AGRILIFE RESEARCH

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SOURCES OF MATERIALS

[1] FiberMax®, Bayer CropScience, Lubbock, TX 79403

[2] All-Tex®, All-Tex Seed, Inc. / Levelland Delinting, Inc., Levelland, TX 79336

[3] Repeller®, Natural Resources Group, Inc., Woodlake, CA 93286

[4] Aza-Direct®, Gowan Company, Yuma, AZ 85366

[5] AgAide®, Brandt Consolidated, Inc., Springfield, IL 62711

[6] Pyganic®, MGK Company, Minneapolis, MN 55427

[7] Sucrashield®, Natural Forces LLC, Davidson, NC 28036

[8] Entrust®, Dow AgroSciences LLC, Indianapolis, IN 46268

[9] Cedar Gard®, Natural Resources Group, Inc., Woodlake, CA 93286

[10] Pest Out®, JH Biotech, Inc., Ventura, CA 93003

[11] Bugitol®, Champon Millennium Chemicals, Inc., Alexandria, VA 22314

[12] Saf-T-Side®, Brandt Consolidated, Inc., Springfield, IL 62711

[13] Surround WP®, NovaSource, Phoenix, AZ 85008

[14] 40% ammonium nonanoate formulation, Emery Oleochemicals, Cincinnati, OH 45232

[15] Gramoxone®, Syngenta Crop Protection, LLC, Greensboro, NC 27419

[16] Firestorm®, Chemtura Corporation, Middlebury, CT 06749

[17] Aim EC®, FMC Corporation, Philadelphia, PA 19103

[18] Boll'd®, Agriliance, LLC, St. Paul, MN 55164

INTRODUCTION

As U.S. demand for organic production has increased in the past 20 years, the demand for organic cotton products has followed. And, as cotton markets have become more global, greater pressure has been placed on cotton growers to produce a consistent, high-quality product to meet demand. Organic growers are charged with producing a high level of quality in an organic production system without use of synthetic agrichemicals or varieties genetically modified through recombinant DNA technology.

Over 95% of the organic cotton currently produced in the U.S. is grown on the Texas High Plains, where growers are faced with management concerns typical of cotton production (weed, pest, water, and fertility management, etc.). However, the climate on the Texas High Plains is distinctly unique from the rest of the U.S. Cotton Belt, where high winds, dramatic temperature swings, and heat and drought stress can be common factors in a typical growing season. Additionally, organic cotton producers rely on late-season killing frost to defoliate their cotton crops; this can leave crops vulnerable to late-season weather events which may reduce fiber quality. It is therefore imperative to grow cotton varieties that can withstand extreme weather events.

In the absence of synthetic agrichemicals or transgenic crop varieties, heavy emphasis is placed on native genetics to integrate with management issues in organic systems. Classical plant breeding has the potential to greatly assist organic cotton production, through the development of cotton varieties that exhibit host plant resistance to multiple cotton pests, are well-adapted to the unique climate of the Texas High Plains, and produce high-quality fiber to meet the rigorous demands of domestic and global markets. At present, there are only a few adapted, non-transgenic cotton varieties available for organic cotton growers on the Texas High Plains. Additionally, those few varieties have not been developed for specific needs of organic systems, which can differ greatly from conventional production systems.

In 2010, the Cotton Improvement Program (CIP) at the Texas A&M AgriLife Research and Extension Center in Lubbock began an initiative to develop new, high-quality cultivars tailored to the unique challenges proffered by organic cotton systems. The first breeding objective was to develop naturally thrips-resistant cultivars with high yield and fiber quality potential. However, the CIP also maintains a number of other nurseries dedicated to developing new cultivars with resistance to drought stress, salinity, Verticillium wilt and bacterial blight pathogens, and root-knot nematodes—some of which are also good candidates for organic production. In 2013, the CIP maintained 11,444 field plots, created 40 new populations, selected 2,302 individual plants, evaluated 5,614 progeny rows, selected 67 new lines for testing, and increased seed of 96 breeding lines for further evaluation. In addition to cultivar development, CIP also evaluated a potential organic IPM system for thrips management and potential organic harvest aid product for desiccating and defoliating an organic cotton crop.

Presented in this bulletin is an overview of the organic cotton research conducted by the Cotton Improvement Program at Lubbock. It is our hope that it will serve to both inform and inspire, as we work together to improve the productivity, competitiveness, and livelihoods of organic cotton growers across Texas and the U.S.

TITLE:

Field Evaluation of Advanced Breeding Lines and Cultivars for Organic Cotton Production on the Texas High Plains, 2012-2013.

AUTHORS:

Dylan Wann, Jane Dever, Megha Parajulee, Mark Arnold, and Heather Flippin; Graduate Research Assistant, Associate Professor, Professor, Senior Research Associate, and Research Assistant.

MATERIALS AND METHODS:

2012:

Test Locations:	Jeremy Brown Farm, near Lamesa, TX, and Texas A&M AgriLife Research and Extension Center, Lubbock, TX
Certified Organic:	Lamesa location was certified organic land; Lubbock location was conventional land, but trial was managed organically
Plot Sizes:	2-row plots; 30-ft length.
Planting Dates:	May 22 (Lamesa) and May 23 (Lubbock)
Design:	Randomized Complete Block Design with 4 blocks (Lamesa) and 3 blocks (Lubbock)
Row Spacing:	40 inches
Planting Pattern:	Solid
Herbicide:	None
Fertilizer:	Lamesa location managed by landowner; none at Lubbock location
Irrigations:	Lamesa location was dryland; 18.20 acre-in. applied May-September at Lubbock location
Insecticide:	None
Harvest Aids:	None
Harvest Dates:	October 31 (Lamesa) and November 13 (Lubbock)

2013:

Test Locations:	Cliff Bingham Farm, near Meadow, TX, and Texas A&M AgriLife Research Station, Halfway, TX.
Certified Organic:	Halfway location was conventional land; Meadow location was certified organic land
Plot Sizes:	2-row plots; 30-ft length
Planting Dates:	May 16 (Halfway) and May 22 (Meadow)
Design:	Randomized Complete Block Design with 4 blocks
Row Spacing:	40 inches
Planting Pattern:	Solid
Herbicide:	Trifluralin @ 1 qt./acre applied March 14 at Halfway location;

	none at Meadow location.
Fertilizer:	65 lb N/acre and 30 lb P_2O_5 /acre applied March 13, and 30 lb N/acre applied June 13 at Halfway location; Meadow location managed by landowner.
Irrigations:	12.52 acre-in applied May-September at Halfway location; Meadow location managed by landowner
Insecticide:	None
Harvest Aids:	None
Harvest Dates:	November 18 (Halfway) and November 20 (Meadow)

RESULTS AND DISCUSSION:

In 2012, twelve advanced cotton breeding lines and four cultivars were evaluated in a certified-organic dryland location (Lamesa) and an organically-managed irrigated location (Lubbock). Yields ranged 180-330 lb/acre in Lamesa (Table 1) and 930-1310 lb/acre in Lubbock (Table 2), with no significant differences among entries. In 2013, four advanced lines were added to the evaluation, and trials were conducted in two irrigated locations near Halfway and Meadow. The Halfway location was on conventional land managed without insecticides, whereas the Meadow location was certified organic land. Yields ranged 980-1490 lb/acre in Halfway (Table 4) and 1060-1550 lb/acre in Meadow (Table 5). Yields among entries varied significantly at Halfway, but were not significantly different at Meadow. Maturity, storm resistance, and HVI fiber quality data for each entry are presented in Tables 1-2 (2012) and Tables 4-5 (2013).

Early-season visual ratings for thrips injury were conducted at the 4-5 true leaf stage in both years on both locations, using a 1-9 visual rating scale (1 = plant death; 9 = no thrips damage). There were a number of differences in thrips tolerance among entries each year, except at Lamesa in 2012 (due to light ambient thrips pressure). In 2012, the “CT” lines (CT = “cold-tolerant”) exhibited the greatest thrips tolerance, which included 07-7-1001CT, 07-7-1020CT, 07-7-1303CT, and 07-7-1407CT, along with 06-45-1104D (Table 3). The most susceptible genotype was TAM 04WB-33s. In 2013, there was heavy ambient thrips pressure at both Halfway and Meadow locations (Table 6). Again, the CT lines exhibited higher levels of tolerance at both locations, but the highest tolerance at both locations was observed in 11-2-802GD, one of the four lines added in 2013. TAM 04WB-33s, again, exhibited the least tolerance to thrips injury at both locations.

Pubescence (leaf hairiness) ratings were also conducted, given the strong correlation between pubescence and leaf grade, especially in organic production where synthetic defoliants are prohibited. A 1-9 visual rating scale for pubescence was used (1 = glabrous; 9 = extremely pubescent). Most entries had minimal pubescence both years, except for 07-7-1001CT, 07-7-1303CT, and Tamcot 73 (Tables 3 and 6). These three entries would likely be poor candidates for organic production, because of the potential for higher leaf grades due to hairy leaves.

Overall, 07-7-519CT, 07-7-1020CT, and 11-2-802GD exhibited excellent combinations of thrips tolerance, minimal pubescence, and yield and fiber quality potential, either comparable or greater than the commercial standards. These lines therefore have clear potential as parent material for future cultivar development or as cultivars for commercial organic cotton production.

Table 1. Dryland yield, maturity, storm resistance, and High-Volume Instrument (HVI) fiber quality data for twelve advanced cotton breeding lines and four cultivars for potential organic production near Lamesa, Texas in 2012.

Entry	Lint Yield	Mature Bolls[a,c]	Storm Rating[b]	Mic	Length	Unif	Strength[c]	Leaf Grade[c]
	lb / acre	%			inches	%	g / tex	
06-21-519FQ	288 a	56 a-d	4.8 a-c	4.4 a-d	1.03 b-d	79.8 a	32.2 a-d	3.3 a-c
06-45-1104D	256 a	45 a-e	4.5 b-d	4.8 a	1.04 b-d	78.3 a	30.8 a-e	1.5 cd
07-7-519CT	269 a	58 a-d	5.3 ab	4.5 a-c	1.06 bc	79.0 a	29.1 c-e	1.0 d
07-7-1001CT	182 a	33 e	3.8 de	4.9 a	0.96 d	76.8 a	28.1 e	3.5 ab
07-7-1020CT	302 a	50 a-e	5.5 a	4.3 b-d	1.03 cd	77.0 a	29.9 b-e	2.0 b-d
07-7-1303CT	195 a	36 de	4.8 a-c	4.0 d	1.05 bc	76.9 a	30.9 a-e	4.0 a
07-7-1407CT	190 a	33 e	4.5 b-d	3.6 e	1.04 b-d	78.0 a	30.5 b-e	1.5 cd
07-14-205FS	300 a	48 a-e	3.5 e	4.1 d	1.15 a	80.7 a	33.7 ab	2.5 a-d
07-14-510FS	246 a	38 c-e	4.0 c-e	4.2 cd	1.07 a-c	77.9 a	28.7 de	2.0 b-d
07-20-1304D	192 a	39 c-e	4.8 a-c	4.7 a	1.09 a-c	79.8 a	32.0 a-d	2.0 b-d
09T#1-1116-FQ	276 a	59 a-c	4.5 b-d	4.6 ab	1.03 cd	76.5 a	28.7 de	1.5 cd
All-Tex[1] Atlas	302 a	43 b-e	4.8 a-c	4.5 a-c	1.01 cd	78.0 a	30.5 b-e	2.0 b-d
FiberMax[2] FM 958	232 a	41 b-e	4.5 b-d	4.6 ab	1.07 a-c	78.9 a	30.4 b-e	2.0 b-d
FiberMax FM 989	307 a	39 c-e	4.0 c-e	4.6 ab	1.09 a-c	79.2 a	31.7 a-e	1.0 d
TAM 04WB-33s	306 a	61 ab	3.8 de	4.2 cd	1.14 ab	82.0 a	34.4 a	1.5 cd
Tamcot 73	334 a	66 a	4.8 a-c	4.0 d	1.08 a-c	80.3 a	32.8 a-c	2.5 a-d

Means within a column followed by the same lowercase letter are not significantly different according to pairwise t-tests at P = 0.05.
[a] Visual estimate of mature bolls, conducted 10/11/2012.
[b] Values based on 1-9 visual rating scale for storm resistance (1 = poor; 9 = excellent), conducted 10/11/2012.
[c] Significant at P = 0.10.

Table 2. Yield, maturity, storm resistance, and High-Volume Instrument (HVI) fiber quality data for twelve advanced cotton breeding lines and four cultivars for potential organic production near Lubbock, Texas in 2012.

Entry	Lint Yield	Mature Bolls[a]	Storm Rating[b]	Mic	Length	Unif	Strength	Leaf Grade
	lb / acre	%			inches	%	g / tex	
06-21-519FQ	1140 a	82 a	4.0 d-f	4.0 a-c	1.17 c	81.8 a	31.3 e-g	1.0 c
06-45-1104D	972 a	80 a	4.3 c-f	3.5 d	1.18 bc	82.6 a	31.4 d-g	2.0 bc
07-7-519CT	1125 a	85 a	6.0 ab	3.8 b-d	1.16 c	82.8 a	31.1 fg	3.0 ab
07-7-1001CT	1207 a	88 a	5.0 a-e	3.8 b-d	1.08 e	82.5 a	30.9 g	3.0 ab
07-7-1020CT	1157 a	90 a	6.0 ab	3.7 b-d	1.15 cd	82.5 a	31.9 d-g	3.0 ab
07-7-1303CT	1096 a	83 a	4.3 c-f	4.1 ab	1.18 bc	81.9 a	32.9 c-e	3.5 a
07-7-1407CT	928 a	78 a	5.7 a-c	2.9 e	1.17 c	82.1 a	32.8 c-f	1.5 c
07-14-205FS	942 a	83 a	3.7 ef	3.6 cd	1.27 a	84.2 a	36.9 a	1.5 c
07-14-510FS	1132 a	83 a	6.3 a	3.5 d	1.19 bc	81.7 a	33.1 cd	1.5 c
07-20-1304D	1182 a	87 a	5.3 a-d	4.0 a-c	1.14 cd	82.5 a	31.4 d-g	1.5 c
09T#1-1116-FQ	1054 a	87 a	5.0 a-e	3.9 a-d	1.19 bc	81.5 a	33.9 bc	1.0 c
All-Tex Atlas	1069 a	87 a	4.7 b-f	4.3 a	1.10 de	82.7 a	32.5 c-g	2.0 bc
FiberMax FM 958	1194 a	85 a	5.0 a-e	4.1 ab	1.17 c	83.2 a	31.8 d-g	1.0 c
FiberMax FM 989	1239 a	83 a	3.7 ef	3.9 a-d	1.15 cd	82.1 a	31.6 d-g	1.0 c
TAM 04WB-33s	1013 a	75 a	3.3 f	3.6 cd	1.23 ab	82.9 a	35.1 ab	1.0 c
Tamcot 73	1312 a	87 a	4.0 d-f	3.5 d	1.16 c	82.8 a	34.1 bc	3.0 ab

Means within a column followed by the same lowercase letter are not significantly different according to pairwise t-tests at P = 0.05.
[a] Visual estimate of mature bolls, conducted 10/25/2012.
[b] Values based on 1-9 visual rating scale for storm resistance (1 = poor; 9 = excellent), conducted 10/25/2012.

Table 3. Visual thrips injury and pubescence ratings on twelve advanced cotton breeding lines and four cultivars for potential in organic production systems near Lamesa and Lubbock, Texas in 2012.

Entry	Thrips Injury Ratings[a]		Pubescence Ratings[b]	
	Lamesa	Lubbock	Lamesa	Lubbock
06-21-519FQ	6.9 a	4.4 cd	3.4 bc	3.0 d-g
06-45-1104D	6.8 a	6.3 ab	3.5 bc	4.7 bc
07-7-519CT	6.4 a	6.1 a-c	3.4 bc	3.5 c-e
07-7-1001CT	6.5 a	7.0 a	5.5 a	6.7 a
07-7-1020CT	6.3 a	6.7 a	4.3 ab	3.3 c-f
07-7-1303CT	7.0 a	6.3 ab	5.5 a	4.3 b-d
07-7-1407CT	6.0 a	6.3 ab	3.0 bc	3.3 c-f
07-14-205FS	7.0 a	3.7 d	3.5 bc	5.0 b
07-14-510FS	7.0 a	4.0 d	3.3 bc	4.7 bc
07-20-1304D	7.0 a	5.0 b-d	4.0 a-c	4.3 b-d
09T#1-1116-FQ	6.8 a	5.0 b-d	2.8 bc	2.0 fg
All-Tex Atlas	6.8 a	3.7 d	2.8 bc	2.3 e-g
FiberMax FM 958	7.5 a	5.7 a-c	3.0 bc	3.0 d-g
FiberMax FM 989	7.3 a	6.0 a-c	2.5 cd	2.3 e-g
TAM 04WB-33s	6.3 a	3.7 d	1.0 d	1.7 g
Tamcot 73	7.0 a	4.3 cd	4.0 a-c	5.7 ab

Means within a column followed by the same lowercase letter are not significantly different according to pairwise t-tests at P = 0.05.
[a] Visual ratings were conducted at 4-5 true leaves, using a 1-9 scale (1 = plant death and 9 = no damage); Lamesa and Lubbock ratings were conducted on 6/20/2012 and 6/14/2012, respectively.
[b] Visual ratings were conducted using a 1-9 scale (1 = glabrous and 9 = extremely pubescent); Lamesa and Lubbock ratings were conducted on 9/26/2012 and 10/2/2012, respectively.

Table 4. Yield, maturity, storm resistance, and High-Volume Instrument (HVI) fiber quality data for sixteen advanced cotton breeding lines and four cultivars for potential organic production near Halfway, Texas in 2013.

Entry	Lint Yield	Mature Bolls[a]	Storm Rating[b]	Mic	Length	Unif	Strength	Leaf Grade[c]
	lb / acre	%			inches	%	g / tex	
06-21-519FQ	1414 ab	58 c-f	4.8 e-g	3.0 a	1.20 ab	81.1 a	35.0 a	3.0 ab
06-45-1104D	1110 d-f	59 b-f	5.5 b-e	2.9 a	1.11 d	80.2 a	32.9 a	1.5 bc
07-7-519CT	1339 a-c	41 g-i	6.8 a	2.9 a	1.12 d	78.4 a	30.3 a	2.0 a-c
07-7-1001CT	1205 b-e	50 f-h	6.0 a-c	3.2 a	1.14 b-d	81.6 a	32.5 a	3.0 ab
07-7-1020CT	1287 a-d	74 ab	6.0 a-c	3.2 a	1.12 d	80.8 a	30.3 a	2.5 a-c
07-7-1303CT	1283 a-e	56 d-g	5.3 c-e	3.1 a	1.20 ab	81.4 a	35.8 a	3.0 ab
07-7-1407CT	1128 c-f	49 f-h	4.3 fg	2.7 a	1.16 b-d	80.8 a	33.5 a	3.0 ab
07-14-205FS	1264 a-e	54 e-h	5.5 b-e	2.9 a	1.16 b-d	80.5 a	32.6 a	1.5 bc
07-14-510FS	1485 a	54 e-h	4.3 fg	3.3 a	1.19 a-c	81.7 a	35.2 a	2.5 a-c
07-20-1304D	1138 c-f	64 b-f	5.5 b-e	3.1 a	1.17 b-d	80.0 a	33.3 a	1.5 bc
09-1-1030FQ	978 f	68 a-e	6.3 ab	3.3 a	1.16 b-d	81.5 a	33.9 a	2.5 a-c
09T#1-1116-FQ	1128 c-f	80 a	5.8 b-d	2.8 a	1.13 cd	79.5 a	31.9 a	1.5 bc
11-2-802GD	1430 a	73 a-c	6.0 a-c	3.0 a	1.17 b-d	79.2 a	32.3 a	1.5 bc
11-2-1103GD	1093 d-f	39 hi	5.0 d-f	3.0 a	1.11 d	80.2 a	31.2 a	1.5 bc
11-14-507V	1377 ab	62 b-f	4.8 e-g	3.3 a	1.15 b-d	79.7 a	33.2 a	3.5 a
All-Tex Atlas	1386 ab	66 a-e	5.0 d-f	3.5 a	1.11 d	80.3 a	30.6 a	1.5 bc
FiberMax FM 958	1437 a	49 f-h	4.0 g	3.1 a	1.16 b-d	81.9 a	33.5 a	1.5 bc
FiberMax FM 989	1336 a-c	72 a-d	4.3 fg	3.0 a	1.19 a-c	81.1 a	33.7 a	2.0 a-c
TAM 04WB-33s	1060 ef	33 i	4.0 g	2.8 a	1.26 a	81.9 a	34.1 a	1.0 c
Tamcot 73	1459 a	69 a-e	5.3 c-e	2.4 a	1.11 d	79.7 a	33.9 a	2.5 a-c

Means within a column followed by the same lowercase letter are not significantly different according to pairwise t-tests at P = 0.05.
[a] Visual estimate of mature bolls, conducted 10/9/2013.
[b] Values based on 1-9 visual rating scale for storm resistance (1 = poor; 9 = excellent), conducted 10/9/2013.
[c] Significant at P = 0.10.

Table 5. Yield, maturity, storm resistance, and High-Volume Instrument (HVI) fiber quality data for sixteen advanced cotton breeding lines and four cultivars for potential organic production near Meadow, Texas in 2013.

Entry	Lint Yield	Mature Bolls[a]	Storm Rating[b]	Mic	Length	Unif	Strength[c]	Leaf Grade
	lb / acre	%			inches	%	g / tex	
06-21-519FQ	1552 a	70 d	4.3 cd	3.9 a	1.12 a	80.5 a	35.1 a-c	3.0 a
06-45-1104D	1247 a	74 b-d	5.5 ab	4.1 a	1.12 a	81.4 a	35.0 a-c	3.0 a
07-7-519CT	1422 a	74 b-d	6.0 a	3.5 a	1.13 a	79.6 a	31.6 cd	4.0 a
07-7-1001CT	1414 a	76 b-d	5.0 a-d	3.3 a	1.19 a	81.9 a	35.7 ab	2.0 a
07-7-1020CT	1255 a	80 a-c	5.5 ab	3.5 a	1.15 a	80.1 a	32.0 b-d	4.0 a
07-7-1303CT	1179 a	74 b-d	4.5 b-d	3.6 a	1.16 a	81.0 a	35.1 a-c	2.5 a
07-7-1407CT	1305 a	71 cd	4.5 b-d	3.0 a	1.20 a	80.4 a	35.4 a-c	4.0 a
07-14-205FS	1486 a	79 a-d	5.0 a-d	4.0 a	1.12 a	80.1 a	33.1 a-d	2.0 a
07-14-510FS	1403 a	78 b-d	4.5 b-d	4.1 a	1.11 a	80.5 a	33.7 a-c	2.5 a
07-20-1304D	1301 a	74 b-d	4.8 b-d	4.2 a	1.04 a	79.2 a	32.1 a-d	3.5 a
09-1-1030FQ	1259 a	88 a	5.3 a-c	3.5 a	1.15 a	80.1 a	35.7 ab	2.5 a
09T#1-1116-FQ	1395 a	88 a	4.5 b-d	3.3 a	1.18 a	79.8 a	37.0 a	3.9 a
11-2-802GD	1388 a	83 ab	4.8 b-d	3.8 a	1.14 a	80.3 a	29.2 d	2.5 a
11-2-1103GD	1309 a	70 d	5.0 a-d	3.9 a	1.10 a	79.6 a	33.8 a-c	2.5 a
11-14-507V	1305 a	80 a-c	4.8 b-d	3.5 a	1.15 a	80.7 a	36.6 a	2.5 a
All-Tex Atlas	1402 a	88 a	4.5 b-d	3.9 a	1.13 a	81.4 a	34.0 a-c	2.0 a
FiberMax FM 958	1395 a	80 a-c	4.3 cd	3.8 a	1.11 a	80.5 a	33.5 a-c	2.5 a
FiberMax FM 989	1354 a	78 b-d	4.3 cd	3.9 a	1.13 a	81.3 a	36.8 a	2.5 a
TAM 04WB-33s	1058 a	82 ab	4.0 d	3.8 a	1.10 a	80.7 a	34.7 a-c	2.5 a
Tamcot 73	1428 a	79 a-d	5.3 a-c	4.0 a	1.13 a	80.3 a	34.9 a-c	3.5 a

Means within a column followed by the same lowercase letter are not significantly different according to pairwise t-tests at P = 0.05.
[a] Visual estimate of mature bolls, conducted 10/2/2013.
[b] Values based on 1-9 visual rating scale for storm resistance (1 = poor; 9 = excellent), conducted 10/2/2013.
[c] Significant at P = 0.10.

Table 6. Visual thrips injury and pubescence ratings on sixteen advanced cotton breeding lines and four cultivars for potential in organic production systems near Halfway and Meadow, Texas in 2013.

Entry	Thrips Injury Ratings[a]		Pubescence Ratings[b]	
	Halfway	Meadow	Halfway	Meadow
06-21-519FQ	3.1 cd	4.8 b-f	4.0 f-i	4.5 c-f
06-45-1104D	3.1 cd	4.3 e-g	6.0 a-c	5.0 b-d
07-7-519CT	4.3 ab	5.6 a-d	5.0 c-f	4.0 d-f
07-7-1001CT	3.6 bc	5.8 a-c	6.3 ab	6.8 a
07-7-1020CT	3.8 bc	5.8 a-c	4.5 e-h	4.5 c-f
07-7-1303CT	4.3 ab	6.3 a	7.0 a	6.3 ab
07-7-1407CT	4.3 ab	6.0 ab	6.0 a-c	4.8 c-e
07-14-205FS	3.1 cd	6.0 ab	3.3 ij	3.3 f-i
07-14-510FS	3.6 bc	5.6 a-d	3.0 ij	3.5 e-h
07-20-1304D	3.9 bc	5.3 a-e	5.3 b-e	4.5 c-f
09-1-1030FQ	3.1 cd	4.3 e-g	2.5 j	2.0 ij
09T#1-1116-FQ	3.6 bc	3.9 fg	3.8 g-i	2.5 g-j
11-2-802GD	4.8 a	6.3 a	4.8 d-g	4.0 d-f
11-2-1103GD	3.3 cd	3.6 fg	3.8 g-i	3.8 d-g
11-14-507V	3.9 bc	4.6 c-f	3.0 ij	3.3 f-i
All-Tex Atlas	2.6 de	4.5 c-f	5.8 b-d	5.5 a-c
FiberMax FM 958	2.8 de	5.4 a-e	3.8 g-i	3.3 f-i
FiberMax FM 989	3.6 bc	4.6 c-f	3.5 h-j	2.3 h-j
TAM 04WB-33s	2.3 e	3.0 g	2.5 j	1.8 j
Tamcot 73	3.3 cd	4.4 d-f	7.0 a	4.8 c-e

Means within a column followed by the same lowercase letter are not significantly different according to pairwise t-tests at P = 0.05.
[a] Visual ratings were conducted at 4-5 true leaves, using a 1-9 scale (1 = plant death and 9 = no damage); Halfway and Meadow ratings were conducted on 6/24/2013 and 6/10/2013, respectively.
[b] Visual ratings were conducted using a 1-9 scale (1 = glabrous and 9 = extremely pubescent); Halfway and Meadow ratings were conducted on 9/27/2013 and 9/26/2013, respectively.

TITLE:

Managing Thrips Using Organically Approved Insecticides, Muleshoe, TX, 2011-2012.

AUTHORS:

Monti Vandiver, R.B. Shrestha, David Kerns, Brant Baugh, Megha Parajulee, Dylan Wann, Jane Dever, and Mark Arnold; Extension Agent – IPM Bailey/Parmer Counties, Research Associate, Extension Entomologist – Cotton, Extension Agent – IPM Lubbock County, Professor, Graduate Research Assistant, Associate Professor, and Senior Research Associate.

MATERIALS AND METHODS:

2011:

Test Location:	Jimmy Wedel Farm, near Muleshoe, TX
Certified Organic:	Yes
Plot Sizes:	4-row plots; 100-ft length
Planting Date:	May 3
Design:	Randomized Complete Block Design with 4 blocks
Row Spacing:	30 inches
Planting Pattern:	Solid
Cotton Variety:	FiberMax FM 958
Herbicide:	None
Fertilizer:	Managed by landowner
Irrigations:	Managed by landowner

Treatments:

1. Repeller[3] (garlic juice) @ 6.4 oz/acre (2.5 gal/acre total volume)
2. Aza-Direct[4] (azadirachtin) @ 6 oz/acre + AgAide[5] organic adjuvant @ 8 oz/100 gal water (2.5 gal/acre total volume)
3. Aza-Direct (azadirachtin) @ 8 oz/acre + AgAide organic adjuvant @ 8 oz/100 gal water (2.5 gal/acre total volume)
4. Aza-Direct (azadirachtin) @ 6 oz/acre + Pyganic 5%[6] (pyrethrins) @ 9 oz/acre + AgAide organic adjuvant @ 8 oz/100 gal water (2.5 gal/acre total volume)
5. SucraShield[7] (sucrose esters) at 1% v/v + AgAide organic adjuvant @ 8 oz/100 gal water (20 gal/acre total volume)
6. Entrust[8] (spinosad) @ 2 oz/acre + AgAide organic adjuvant @ 8 oz/100 gal water (20 gal/acre total volume)
7. Cedar Guard[9] (cedar oil) @ 1 qt./acre (20 gal/acre total volume)
8. Pest Out[10] (cotton seed/clove/garlic oils) @ 1% v/v + AgAide organic adjuvant @ 8 oz/100 gal water (20 gal/acre total volume)

9. Pyganic 5% (pyrethrins) @ 18 oz/acre (50 gal/acre total volume)
10. Bugitol[11] (capsicum/mustard oils) @ 96 oz/100 gal (50 gal/acre total volume)
11. Saf-T-Side[12] (petroleum oil) @ 1% v/v + Ecotec (rosemary/peppermint oils) @ 1 qt./100 gal (50 gal/acre total volume)
12. Saf-T-Side (petroleum oil) @ 1% v/v + Pyganic 5% (pytrethrins) @ 9 oz/100 gal (50 gal/acre total volume)
13. Surround WP[13] (kaolin) @ 25 lb./acre + AgAide organic adjuvant @ 8 oz/100 gal water (50 gal/acre total volume)
14. Non-sprayed control

Harvest Aids: None
Harvest Date: November 11

2012:

Test Location: Jimmy Wedel Farm, near Muleshoe, TX
Certified Organic: Yes
Plot Sizes: 4-row plots; 45-ft length
Planting Date: May 1
Design: Randomized Complete Block Design with 4 blocks
Row Spacing: 30 inches
Planting Pattern: Solid
Cotton Variety: FiberMax FM 958
Herbicide: None
Fertilizer: Managed by landowner
Irrigations: Managed by landowner
Treatments:

1. Aza-Direct (azadirachtin) @ 16 oz/acre + AgAide organic adjuvant @ 8 oz/100 gal water (30 gal/acre total volume)
2. Entrust (spinosad) @ 2 oz/acre + AgAide organic adjuvant @ 8 oz/100 gal water (30 gal/acre total volume)
3. Bugitol (capsicum/mustard oils) @ 96 oz/100 gal (30 gal/acre total volume)
4. Saf-T-Side (petroleum oil) @ 1% v/v + Ecotec (rosemary/peppermint oils) @ 1 qt./100 gal (50 gal/acre total volume)
5. Non-sprayed control

Harvest Aids: None
Harvest Dates: November 1

RESULTS AND DISCUSSION:

In 2011, an on-farm field trial was initiated to evaluate the impact of 13 organically-approved insecticide treatments on thrips control in an organic cotton system. Insecticide applications were made weekly, beginning at emergence and continuing through the 5th true leaf stage. Collected data included thrips numbers at 3-4 and 7-8 days after each treatment (DAT), visual injury ratings at 5 weeks after planting (WAP), and final lint yield. Visual injury ratings were conducted on a 1-5 visual rating scale, where 1 = no visible damage and 5 = severe injury.

Environmental conditions in 2011 were harsh: extremely dry, warmer than normal, and very windy. Therefore, ambient thrips pressure, was significantly lower compared to historical observations, likely due to harsh conditions and lack of alternative hosts to support and bridge thrips populations until cotton emergence. Thrips numbers slightly exceeded the established action threshold of one thrips per true leaf by May 23 and remained above action threshold through May 27. No significant differences were observed among any treatments during this time (Fig. 1). Thrips pressure remained below threshold through the rest of the sampling period and no significant treatment differences were present between treatments.

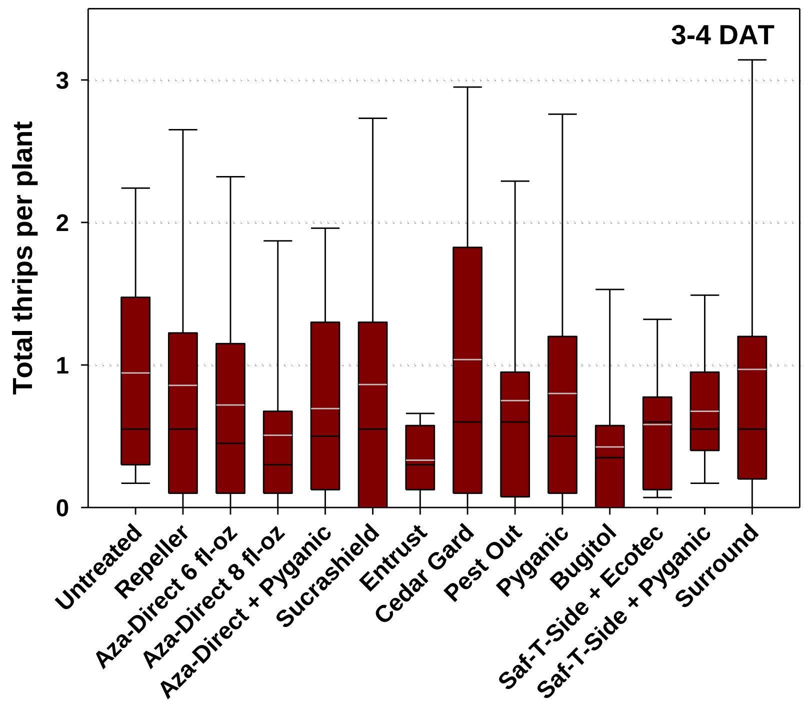
The percentage of immature thrips of a population is a good indicator of that population's ability to colonize; a higher percentage of immatures suggests a higher degree of colonization. Across all sampling dates, the Entrust treatment had a significantly lower percentage of immature thrips compared to all other treatments (Fig. 2). Based on these data, Entrust appeared to suppress colonization to a greater degree than the other treatments. Similarly, Entrust resulted in the lowest visual rating (Fig. 3), indicating a reduced amount of thrips injury. Yields among all treatments averaged 1125 lb/acre, with no differences among treatments. Entrust appears to have the greatest capacity for reducing thrips infestations in an organic cotton crop, although this didn't translate to a yield benefit in 2011. The Aza-Direct, Bugitol, and Saf-T-Side + Ecotec also exhibited some potential level of thrips mitigation.

In 2012, the number of insecticide treatments was reduced to include only the Aza-Direct, Bugitol, Entrust, and Saf-T-Side + Ecotec treatments, along with the non-sprayed control. These products were selected based on 2011 evaluations, having displayed the greatest potential for thrips mitigation. In the 2012 test, insecticide applications were made weekly, beginning at 85% emergence and continuing for 5 weeks. Thrips were again collected from plant samples 3-4 and 6-7 DAT each week and visual injury ratings conducted at the 6th true leaf stage.

Ambient thrips populations were less than 50% of an action threshold when the first insecticide application was made (May 19). By May 23, they were near 5x the action threshold (1 thrips/true leaf) and remained near or above the threshold through the 5th true leaf stage. Similar to 2011, Entrust was the only treatment that significantly reduced thrips numbers compared to the control at 3 DAT, across all samplings (Fig. 4). However, there were no significant differences in thrips numbers among treatments at 7 DAT, although Entrust maintained a positive position relative to other treatments. Entrust also significantly reduced visible thrips damage and the percentage of immature thrips (Fig. 5), compared to all other treatments. Lint yields averaged 788 lb/acre, but were, again, not different among treatments.

Based on these results, Entrust (spinosad) was the only evaluated insecticide that consistently reduced thrips numbers and subsequent thrips injury over the control both years. Entrust, therefore, has clear potential for thrips management in an organic cotton crop. However, the present cost of Entrust is substantial enough to potentially be cost-prohibitive for large acreages typical of organic cotton farms on the Texas High Plains. Integration of Entrust applications with thrips-resistance cotton varieties may provide the most cost-effective level of thrips management for organic cotton production.

Fig. 1. Seasonal mean thrips per plant at 3-4 and 7-9 days after treatment (DAT) of 13 organically-approved insecticides on cotton near Muleshoe, Texas in 2011.



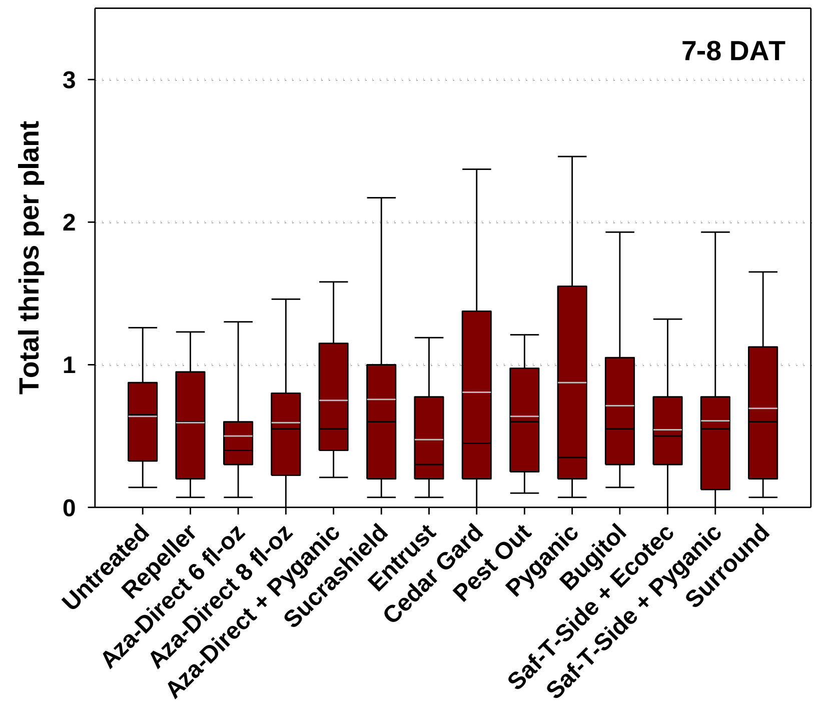
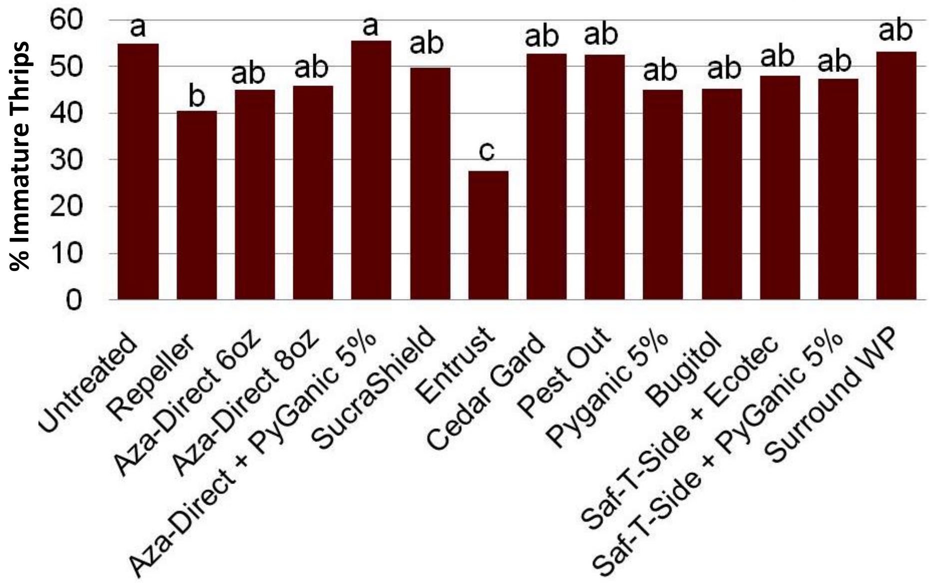
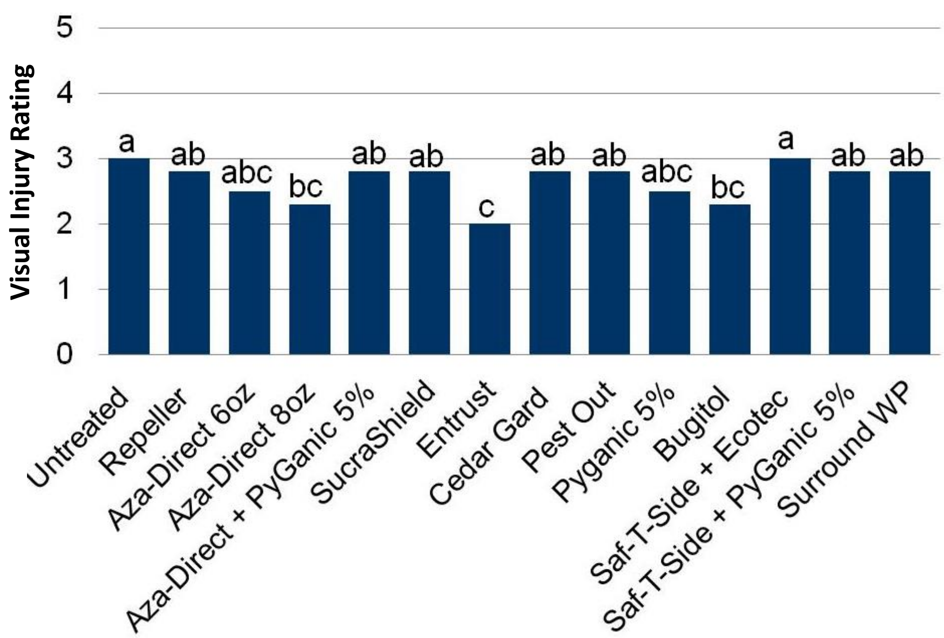


Fig. 2. Seasonal means of percent immature thrips, following 5 applications of 13 organically-approved insecticides on cotton near Muleshoe, Texas in 2011.



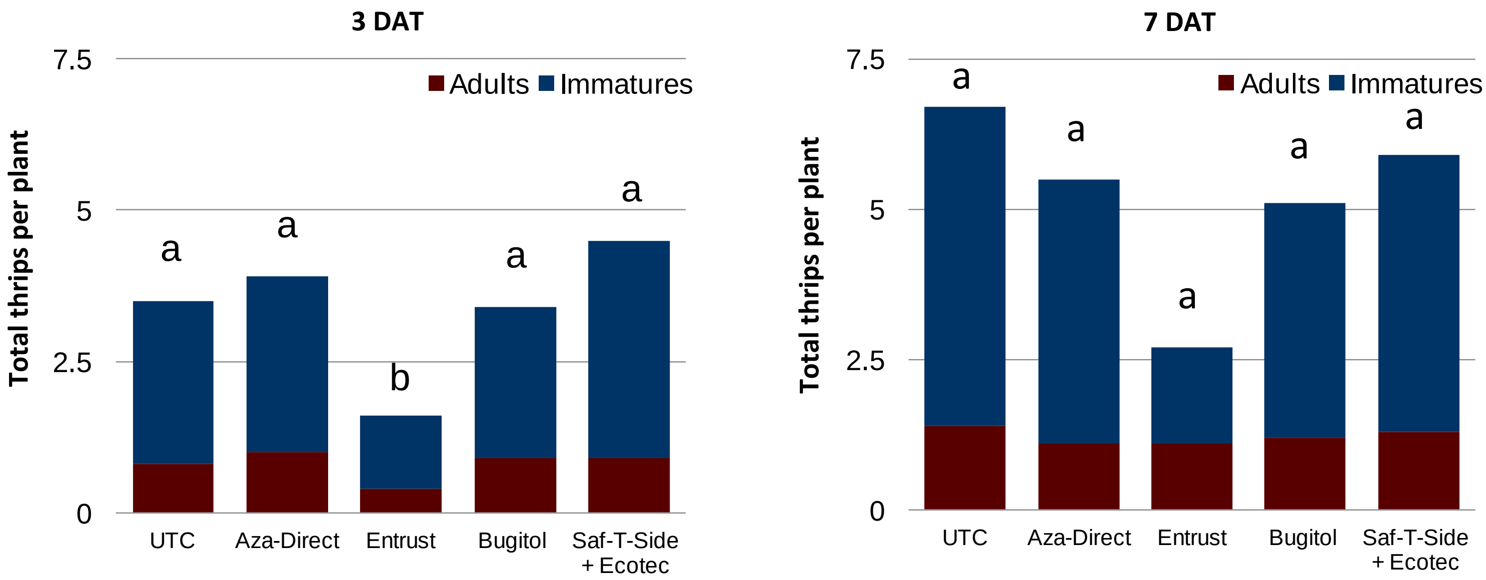
Means within a column followed by the same lowercase letter are not significantly different according to Fisher's Protected LSD test at P = 0.05.

Fig. 3. Visual thrips injury ratings following 5 applications of 13 organically-approved insecticides on cotton near Muleshoe, Texas in 2011.



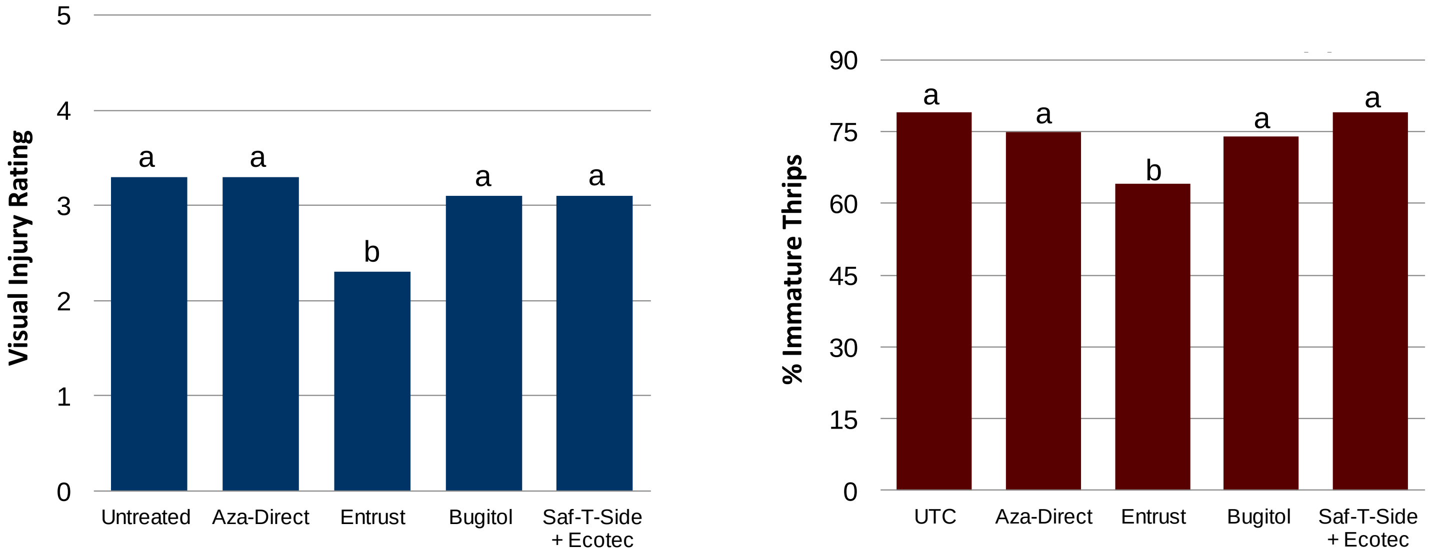
Means within a column followed by the same lowercase letter are not significantly different according to Fisher's Protected LSD test at P = 0.05.

Fig. 4. Seasonal mean thrips per plant at 3 and 7 days after treatment (DAT) of 4 organically-approved insecticides on cotton near Muleshoe, Texas in 2012.



Means within a column followed by the same lowercase letter are not significantly different according to Fisher's Protected LSD test at P = 0.05.

Fig. 5. Visual thrips injury ratings and seasonal means of percent immature thrips following 5 treatments of 4 organically-approved insecticides on cotton near Muleshoe, Texas, 2012.



Means within a column followed by the same lowercase letter are not significantly different according to Fisher's Protected LSD test at P = 0.05.

TITLE:

Managing Thrips in Organic Cotton with Host Plant Resistance and Spinosad Insecticide, Muleshoe, TX, 2013.

AUTHORS:

Dylan Wann, Monti Vandiver, Jane Dever, Mark Arnold, Megha Parajulee, and Apurba Barman; Graduate Research Assistant, Extension Agent – IPM Bailey/Parmer Counties, Associate Professor, Senior Research Associate, Professor, and Assistant Professor.

MATERIALS AND METHODS:

Test Location:	Jimmy Wedel Farm, near Muleshoe, TX.
Certified Organic:	Yes
Plot Sizes:	4-row plots; 25-ft length
Planting Date:	May 13
Design:	Split Plot Design with 4 blocks
Row Spacing:	30 inches
Planting Pattern:	Solid
Cotton Genotypes:	07-7-1020CT
	07-7-1407CT
	All-Tex Atlas
	FiberMax FM 958
Herbicide:	None
Fertilizer:	Managed by landowner
Irrigations:	Managed by landowner
Treatments:	Entrust (spinosad) @ 2 oz/acre (26.5 gal/acre total volume) + AgAide organic adjuvant @ 8 oz/100 gal water, applied May 28, June 4, and June 11 on treated plots; all others received no insecticide applications.
Harvest Aids:	None
Harvest Dates:	October 30

RESULTS AND DISCUSSION:

In 2013, an on-farm trial was initiated to evaluate the combined effects of resistant genotypes with an organic-approved insecticide for integrated thrips control. The test was conducted on a cooperator's certified organic land near Muleshoe, TX, an area noted for consistently heavy ambient thrips pressure. Two thrips-tolerant lines (07-7-1020CT and 07-7-1407CT), a susceptible check (All-Tex Atlas), and commercial standard (FiberMax FM 958) were planted and subjected to three weekly spray treatments of Entrust, an organic-approved spinosad insecticide with proven efficacy on thrips pests, beginning at near 100% emergence (May 28). Spray treatments consisted of weekly sprays or no sprays on each entry, in a split plot experimental design, with entry as the main plots and spray treatments as subplots. Collected data included thrips numbers and single leaf areas (at 1-5 weeks after planting [WAP]), and visual injury ratings at 5 WAP. For the sake of brevity, only sampling dates that exhibited significant differences among entries and/or treatments are presented herein. Additionally, a late-season hail event (following thrips sampling and evaluations) severely damaged all plots in the test. The plots were hand-harvested, but yields were too low and inconsistent to report among treatments. However, reliable HVI fiber quality data was collected and is also reported herein.

At 4 WAP, the combination of 07-7-1020CT and FM 958 with Entrust resulted in the lowest thrips numbers (Table 1). Similarly, 07-7-1020CT, 07-7-1407CT, and FM 958 combined with Entrust resulted in the least thrips injury. Finally, 07-7-1020CT and 07-7-1407CT resulted in the greatest single leaf area, despite significant ambient thrips pressure. Given these data, either 07-7-1020CT or 07-7-1407CT, combined with weekly Entrust applications, would result in the least amount of thrips damage to an organic cotton crop. Genotype had no effect on thrips numbers at 4 WAP or 5 WAP (Table 2). However, both 07-7-1020CT and 07-7-1407CT displayed less visual thrips injury and subsequently greater single leaf area at 5 WAP. Therefore, either of these lines would be good candidates for growers to utilize in an integrated thrips management system. Entrust applications also resulted in significantly lower thrips numbers than no sprays at 4 WAP and 5 WAP. Similarly, Entrust applications reduced visual thrips feeding injury and increased single leaf area by 5 WAP. Entrust applications had no significant impact on HVI fiber quality. However, there were significant differences among genotypes for all evaluated HVI properties except leaf grade (Table 3).

These results suggest that it is possible to significantly mitigate thrips damage on an organic cotton crop under heavy pressure, using a combination of Entrust insecticide applications and resistant varieties. Thrips-tolerant genotypes alone reduced visual thrips injury by 31%, whereas Entrust applications reduced injury by 37%. Together, resistant genotypes + Entrust reduced visible damage by 83%. However, the current price of Entrust may render this IPM system as too cost-prohibitive. In this case, utilizing resistant cotton varieties would be a comparable, more-affordable option for reducing losses to thrips damage than organically-approved insecticides. This test will be repeated in 2014 to further verify these results.

Table 1. Interactive effects of genotype and insecticide application on thrips numbers and visual injury, and single leaf area on an organic cotton crop near Muleshoe, Texas in 2013.

Genotype	Sprayed	Thrips, 4 WAP[a]	Visual Injury Ratings[b,c]	Single Leaf Area[c]
		no./10 plants		cm^2/leaf
07-7-1020CT	No	358 a	4.1 bc	4.5 a-c
	Yes	175 cd	5.0 ab	5.1 a
07-7-1407CT	No	371 a	3.9 bc	4.7 ab
	Yes	215 b-d	5.5 a	5.4 a
All-Tex Atlas	No	310 a-c	3.1 c	3.5 cd
	Yes	198 b-d	4.1 bc	3.8 b-d
FiberMax FM 958	No	327 ab	3.0 c	3.4 d
	Yes	170 d	4.6 ab	4.9 ab

Means within a column followed by the same lowercase letter are not significantly different according to pairwise t-tests at P = 0.05.
[a] Weeks after planting.
[b] Visual ratings were conducted on a 1-9 scale (1 = plant death; 9 = no damage).
[c] Observed at 5 WAP.

Table 2. Pooled effects of genotype and insecticide application on thrips numbers and visual injury, and single leaf area on an organic cotton crop near Muleshoe, Texas in 2013.

Treatment	Thrips, 4 WAP[a]	Thrips, 5 WAP	Visual Injury Ratings[b,c]	Single Leaf Area[c]
	-----no./10 plants----			cm^2/leaf
<u>Genotype</u>				
07-7-1020CT	266 a	53 a	4.6 a	4.8 a
07-7-1407CT	293 a	40 a	4.7 a	5.0 a
All-Tex Atlas	254 a	41 a	3.6 b	3.6 b
FiberMax FM 958	249 a	44 a	3.8 b	4.1 ab[d]
<u>Sprayed</u>				
No	341 a	57 a	3.5 b	4.0 b
Yes	189 b	32 b	4.8 a	4.8 a

Means within a column followed by the same lowercase letter are not significantly different according to pairwise t-tests at P = 0.05.
[a] Weeks after planting.
[b] Visual ratings were conducted on a 1-9 scale (1 = plant death; 9 = no damage).
[c] Observed at 5 WAP.
[d] Significant at P = 0.10.

Table 3. Pooled effects of genotype and insecticide application on HVI fiber quality of an organic cotton crop near Muleshoe, Texas in 2013.

Treatment	Mic[a]	Length	Unif[a]	Strength[a]	Leaf Grade
		inches	%	g/tex	
Genotype					
07-7-1020CT	3.5 b	1.05 b	79.6 ab	30.5 a	1.5 a
07-7-1407CT	3.5 b	1.07 a	78.4 b	27.5 c	1.5 a
All-Tex Atlas	4.0 a	1.01 c	79.5 ab	27.7 bc	1.5 a
FiberMax FM 958	3.9 ab	1.06 ab	80.9 a	30.1 ab	1.0 a
Sprayed					
No	3.7 a	1.05 a	79.7 a	29.2 a	1.3 a
Yes	3.7 a	1.04 a	79.5 a	28.6 a	1.5 a

Means within a column followed by the same lowercase letter are not significantly different according to pairwise t-tests at P = 0.05.
[a] Significant at P = 0.10.

TITLE:

Evaluation of Organic-Approved Ammonium Nonanoate Herbicide as a Potential Harvest Aid in Cotton, Lubbock, TX, 2012-2013.

AUTHORS:

Dylan Wann, Jane Dever, Mark Kelley, Ryan Gregory, and Trey Cutts; Graduate Research Assistant, Associate Professor, Extension Agronomist – Cotton, Graduate Research Assistant, and former Graduate Research Assistant.

MATERIALS AND METHODS:

2012 Pre-Test:

Test Location:	Texas A&M AgriLife Research and Extension Center, Lubbock, TX
Plot Sizes:	2-row plots; 30-ft length
Design:	Randomized Complete Block Design with 3 blocks
Row Spacing:	40 inches
Planting Pattern:	Solid
Evaluated Product:	40% ammonium nonanoate[14] (AN) experimental formulation
Treatments:	

1. 1.7 gal AN/acre
2. 3.4 gal AN/acre
3. 6.7 gal AN/acre
4. Gramoxone[15] (paraquat) @ 24 oz/acre
5. Non-sprayed control

Treatment Date:	October 15; all treatments were applied @ 15 gal/acre spray volume
Harvest Date:	October 25

2013:

Test Location:	Texas A&M AgriLife Research and Extension Center, Lubbock, TX
Evaluated Product:	40% AN experimental formulation
Plot Sizes:	2-row plots; 30-ft length
Design:	Randomized Complete Block Design with 3 blocks
Row Spacing:	40 inches
Planting Pattern:	Solid
Irrigations:	12.74 acre-in applied May-September.
Treatments:	

1. 2.5 gal AN/acre

2. 3.4 gal AN/acre
3. 6.7 gal AN/acre
4. Firestorm[16] (paraquat) @ 2.1 oz/acre
5. Aim EC[17] (carfentrazone) @ 1 oz/acre
6. Aim EC (carfentrazone) @ 1 oz/acre + Boll'd[18] (ethephon) @ 2 lb/acre
7. Non-sprayed control

Treatment Date: October 22; all treatments were applied @ 15 gal/acre spray volume
Harvest Date: November 13

RESULTS AND DISCUSSION:

2012 Pre-Test:

Field trials were initiated in the fall of 2012 on conventional land to evaluate an organically-approved herbicide for potential as a harvest aid in cotton. A pre-test was conducted in 2012 to determine proof-of-concept of the product, an experimental formulation of 40% ammonium nonanoate (AN). Three experimental rates were evaluated, based on previous work with the product as a broad-spectrum herbicide in other crops, and were compared to a commercial conventional standard (Gramoxone). Visual estimates of percent desiccated leaves, remaining green leaves, and open bolls were conducted 1 day after treatment (DAT). These parameters were re-evaluated at 10 DAT, in addition to a visual defoliation estimate. Seed cotton from 15 bolls in each plot was hand-collected, following the 10 DAT ratings and subsequently analyzed for HVI fiber quality.

All AN treatments rapidly desiccated the treated cotton within 24 hours of application compared to the non-sprayed control (Table 1). Similarly, all AN treatments reduced green leaves within 24 hours compared to the control. None of the treatments affected open bolls at 1 DAT. At 10 DAT, all of the sprayed treatments increased desiccation of remaining leaves over the control (Table 1), but were not different from one another. Similarly, all sprayed treatments reduced green leaves compared to the control at 10 DAT. However, the 6.7 gal AN/acre and Gramoxone treatments resulted in the least amount of green leaves, but were not different from the 3.4 gal AN/acre rate. None of the treatments significantly affected percent open bolls, compared to the control. Finally, the 3.4 gal AN/acre, 6.7 gal AN/acre, and Gramoxone treatments all significantly increased defoliation over the control and 1.7 gal AN/acre treatments, but were not different from one another. These data suggest that, while the 3.4 gal AN/acre rate exhibited a slower impact on cotton at 1 DAT, it resulted in an equivalent level of overall defoliation by 10 DAT. This is advantageous in that it would require less product, but would achieve comparable defoliation as the highest AN rate and Gramoxone. None of the AN rates displayed any significant effect on boll opening.

None of the AN or Gramoxone treatments had a significant effect on HVI micronaire, length, length uniformity, bundle strength, or leaf grade (Table 2). However, increasing AN rates improved fiber elongation, which is a positive outcome. This could possibly be the result of the AN removing some of the waxes and other lipid-based compounds on the cotton fiber, thereby improving the overall elasticity of the fiber. Increased fiber elongation is generally desirable, because it improves the ability of the fiber to resist breakage during the yarn-spinning process.

2013 Test:

This test was repeated in 2013, with a 2.5 gal AN/acre rate replacing the 1.7 gal AN/acre rate. Additionally, AN treatments were applied at varying spray volumes (15 gal/acre versus 20 gal/acre), to determine if less product would have acceptable efficacy at a higher spray volume. There was no significant difference in AN efficacy among spray volumes, so only the 15 gal/acre treatments are reported herein. The commercial standards were expanded to include Aim EC (carfentrazone) and Aim EC + Boll'd (ethephon), both of which represent standard harvest aid regimes for conventional cotton production on the Texas High Plains. Spray applications were made when the cotton had reached approximately 70-80% open bolls. Visual estimates of percent desiccated leaves, open bolls, and defoliation were conducted at 1, 5, and 10 DAT. Seed cotton samples were machine-harvested from each plot, following the 10 DAT ratings and subsequently analyzed for HVI fiber quality. However, those fiber samples are being processed at present, so those data will not be presented in this report.

At 1 DAT, there were a number of differences among treatments in leaf desiccation and open bolls, and even some level of defoliation (Table 3), unlike the 2012 pre-test, where no defoliation occurred at 1 DAT. All AN treatments rapidly desiccated the cotton, over the control and commercial treatments. Additionally, all AN treatments resulted in more open bolls than Firestorm, and the 3.4 gal AN/acre and 6.7 gal AN/acre resulted in some level of defoliation over the control and Aim EC treatments. At 5 DAT, all sprayed treatments increased leaf desiccation over the control, but did not differ from one another (Table 3). Also, the 3.4 gal AN/acre, Firestorm, and Aim EC + Boll'd increased defoliation over the control. There were no boll opening differences among any treatments. At 10 DAT, all sprayed treatments, again, increased leaf desiccation over the control but did not differ amongst themselves (Table 3). Similarly, all spray treatments increased defoliation over the control, but did not differ significantly among treatments. There were no differences in open bolls among all treatments. These results suggest that by 10 DAT, the evaluated AN rates were comparable to Gramoxone and Aim EC treatments in both desiccation and defoliation activity.

Overall, the results from the 2012 and 2013 evaluations suggest that a rate as low as 3.4 gal AN/acre exhibits levels of leaf desiccation and defoliation in a cotton crop comparable to the conventional commercial standards. The evaluated AN rates increased defoliation 40-350% over the control, but had little or no boll-opening activity. Additionally, use of AN as a harvest aid appears to have no negative effects on fiber quality. However, current price estimates for 40% AN formulations may render this rate as too cost-prohibitive for use in an organic cotton system. Trials will be conducted in 2014 to further confirm these results.

Table 1. Visual estimates of percent desiccation, intact green leaves, open bolls, and defoliation at 1 and 10 days following four defoliant treatments near Lubbock, Texas in 2012.

Treatment	1 DAT[a]			10 DAT			
	Desiccation	Green leaves	Open bolls	Desiccation	Green leaves	Open bolls	Defoliation
	--%			--			
Control	25 d	75 a	58 a	13 b	75 a	87 a	12 c
1.7 gal AN/acre	53 c	47 b	63 a	32 a	37 b	83 a	32 b
3.4 gal AN/acre	70 b	30 c	72 a	27 a	19 bc	83 a	55 a
6.7 gal AN/acre	83 a	17 d	70 a	30 a	7 c	83 a	63 a
Gramoxone	88 a	12 d	73 a	30 a	7 c	88 a	63 a

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

Table 2. HVI fiber properties of cotton following four defoliant treatments near Lubbock, Texas in 2012.

Treatment	Micronaire	Length	Length Uniformity	Bundle Strength	Elongation	Leaf Grade
		inches	%	g/tex	%	
Control	4.9 a	1.11 a	83.9 a	31.4 a	9.4 c	3.7 a
1.7 gal AN/acre	5.1 a	1.12 a	83.8 a	32.1 a	10.2 ab	3.7 a
3.4 gal AN/acre	5.0 a	1.13 a	83.8 a	32.1 a	10.4 a	2.3 a
6.7 gal AN/acre	5.1 a	1.11 a	83.2 a	31.3 a	10.7 a	2.3 a
Gramoxone	4.9 a	1.12 a	83.5 a	30.5 a	9.6 bc	3.0 a

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

Table 3. Visual estimates of percent desiccation, open bolls, and defoliation at 1, 5, and 10 days following six defoliant treatments near Lubbock, Texas in 2013.

Treatment	1 DAT[a]			5 DAT			10 DAT		
	Dessication	Open bolls	Defoliation	Dessication	Open bolls	Defoliation[b]	Dessication	Open bolls	Defoliation
	---	---	---	---	%	---	---	---	---
Control	11 c	81 bc	32 c	21 b	87 a	37 c	30 b	90 a	55 b
2.5 gal AN/acre	69 a	85 ab	45 a-c	72 a	86 a	47 bc	82 a	88 a	78 a
3.4 gal AN/acre	81 a	84 ab	47 ab	82 a	88 a	66 ab	91 a	90 a	80 a
6.7 gal AN/acre	84 a	88 a	51 a	90 a	91 a	59 a-c	93 a	95 a	75 a
Firestorm	47 b	78 c	35 bc	91 a	96 a	73 a	96 a	96 a	88 a
Aim EC	18 c	83 a-c	32 c	81 a	84 a	55 a-c	87 a	88 a	85 a
Aim EC + Boll'd	21 c	83 a-c	35 bc	68 a	86 a	71 ab	90 a	93 a	83 a

Means within a column followed by the same lowercase letter are not significantly different according to multiple pairwise t-tests at P = 0.05.
[a] Days after treatment.
[b] Significant at P = 0.10.

TITLE:

Development of Thrips-Resistant Cultivars for Organic Cotton Production, Lubbock, TX, 2010-2013.

AUTHORS:

Dylan Wann, Jane Dever, Mark Arnold, and Heather Flippin; Graduate Research Assistant, Associate Professor, Senior Research Associate, and Research Assistant.

DESCRIPTION:

Given the extremely limited scope of available cotton varieties for organic production on the Texas High Plains, there is a need for more non-transgenic, highly-productive varieties available for organic growers. In certified organic production, synthetic insecticide use is prohibited by USDA and TDA organic guidelines and there is little or no information available on effective, organically-approved products for thrips management. Using resistant crop varieties may be a viable alternative to direct thrips control, where insecticides may be unavailable or cost-prohibitive for organic growers. A thrips nursery has been maintained at the Texas A&M AgriLife Research and Extension Center in Lubbock since 2010, for the development of new varieties with high levels of thrips tolerance combined with yield and fiber quality potential.

RESULTS AND DISCUSSION:

Gossypium barbadense L. (Pima) exhibits a high level of thrips tolerance as a species; therefore, crossing *G. barbadense* accessions with *Gossypium hirsutum* L. (Upland) accessions has the potential for producing an Upland-type cotton plant that also expresses a high level of Pima-type thrips tolerance. All entries in the thrips nursery are selected for early-season thrips tolerance and late-season agronomic performance. Broad-sense heritability (proportion of physical variation controlled by genetic factors) for thrips resistance ranges 35-75%, depending on the family. These heritability values indicate that we can confidently select for thrips resistance based on visual selection alone. As a result, a 21% gain in thrips resistance per cycle of selection has been observed in this program (at a 5% selection intensity). To date, 13 different interspecific crosses have been grown in the field, and 622 individual plants and 12 whole rows have been selected since 2010 that exhibit high thrips tolerance or excellent yield and fiber quality. Seed from selected plants/rows is then planted and subjected to repeated selection over subsequent growing seasons. Selected F_6 whole rows will be tested for potential transgenic contamination—non-contaminated lines are then entered into small-plot yield evaluations.

In 2014, F_4 and F_6 generations will be planted in the nursery for selection and 7 F_7 lines will enter the first year of yield testing. Typically, lines undergo three consecutive years of yield testing before becoming eligible for potential release as a cultivar.