2013 Extension Cotton Project Annual Report

Southwest Research and Extension Center, Altus

In cooperation with the Oklahoma State University Integrated Pest Management Program

2013 Extension Cotton Report

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An effective cotton integrated pest management (IPM) program includes all aspects of production. This report contains summarized data from various applied research trials and demonstrations that address many different cotton production components. The drought that began basically at the end of 2010 continues for the heart of cotton country in southwestern Oklahoma (Figure 1).

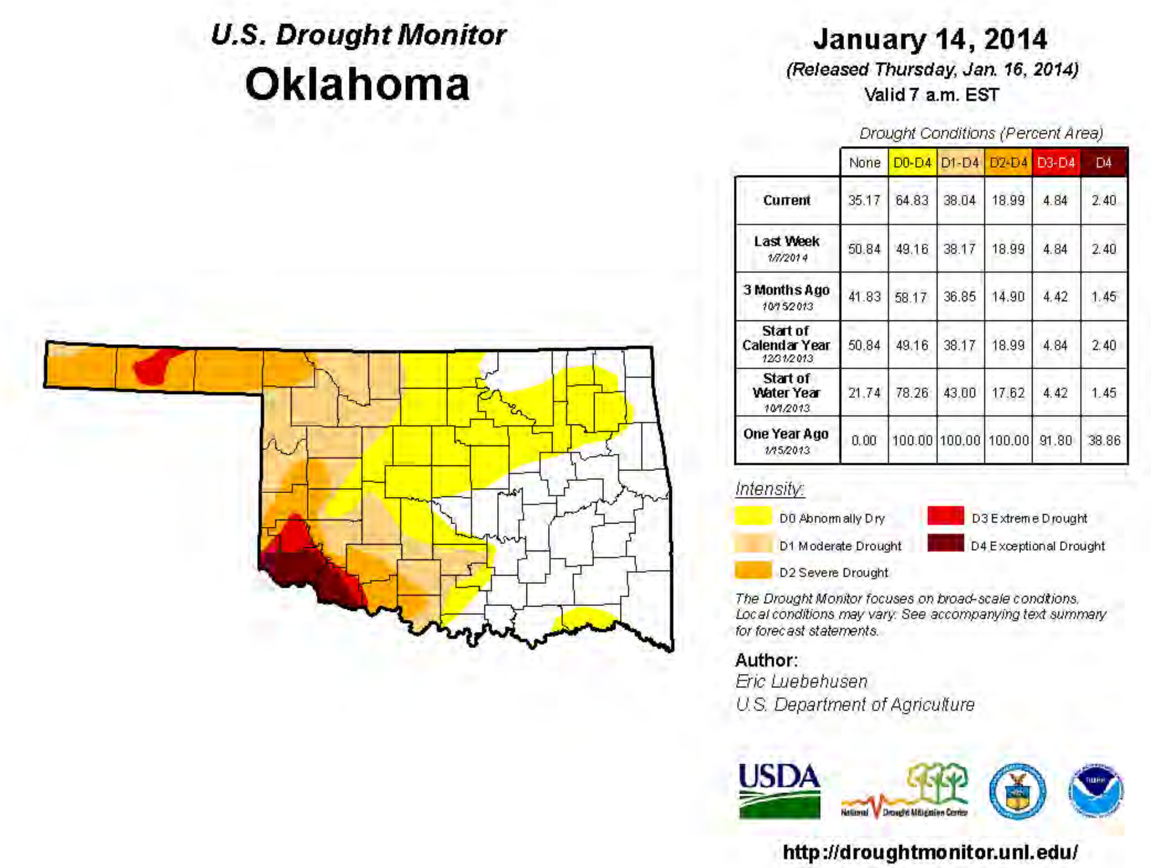

Figure 1. Oklahoma drought situation, January 14, 2014.

Although early season rainfall resulted in good to excellent stands and early season vigor for dryland production, an extensive run of hot dry, conditions resulted in another dryland failure in Jackson, Tillman and Harmon counties. We were basically one rainfall event away from having a good dryland year. According to USDA-NASS, about 185,000 acres were planted in Oklahoma in 2013, with about 170,000 acres harvested. From this harvested acreage, NASS estimates 200,000 bales will be produced. Average yield is expected to be 565 pounds per acre, up 34 pounds from 2012. This was due to extreme drought conditions, mostly in the far southwestern corner of the state. In general the crop emerged and grew off fairly well, but lack of moisture in August resulted in a large number of abandoned acres in three southwestern counties which are essential for high production. Most cotton acreage in Jackson County failed due to drought. This is because there was no irrigation water available to the Lugert-Altus Irrigation District and this would indicate that somewhere around 40,000 acres failed. Tillman County failed a large number of dryland acres, perhaps 10,000 acres. Harmon County also failed some dryland cotton acres. Therefore, we submit that the failed acres in these three counties totals about 50,000-60,000. If we use 60,000 failed acres, then based on 185,000 planted, we should be looking at about 125,000 acres standing for harvest. After informal discussions with our 14 operational gins in December 2013, it was apparent that they were expecting a combined total of about 120,000 bales. This number is substantially lower than what USDA-NASS reported in the December 10 report (200,000 bales). As of February 10, 2014, a total of 126,000 Oklahoma bales had been classed at the USDA-AMS Classing Office in Abilene, TX.

Overall, across the state, Oklahoma producers experienced a roller-coaster year. We still have dry watersheds for important reservoirs in the southwestern corner of the state, and for the second consecutive year, no irrigation water was available to the Lugert-Altus Irrigation District. Some Oklahoma producers which were able to catch some timely rainfall and provide adequate supplemental irrigation, saw record yields. Producers in several counties reported 3-4+ bale/acre irrigated yields. Dryland fields in areas that received excellent summer rainfall produced 1.5 – 2.5 bale/acre crops. For many irrigated producers, the right factors aligned, and resulted in record yields. We attribute this to wise variety selection, the cool-off and rainy spell in late July, then a September that was about 30 percent above normal for cotton heat unit accumulation. Overall, it was great to see this success, and we believe that in 2013, we very likely set a record for the number of growers who have achieved 4 bale/acre production.

The other good news is that the USDA-AMS Classing Office at Abilene is reporting that color and leaf grades, staple, micronaire, strength, uniformity, and bark contamination have all been good to excellent. This is based on classing results for about 126,000 bales of Oklahoma cotton classed through February 10, 86% have been color grades 11, 21 or 31, with 53% with color grade 11 or 21 – the best possible. Leaf grades have averaged 2.7 with 49% exhibiting leaf grade 1 or 2 – the best quality possible. Bark contamination is present in about 26% of the bales classed thus far. Staple (fiber length) has averaged 35.2 32nds. This is good, and we have nearly one-third of the crop with a 37 or longer staple, with an additional 20% classed as a 36. Micronaire (a measure of maturity) averaged 4.0 units, with 82% in the 3.5-4.9 range. Currently our strength average is 30.4 g/tex, with nearly 70% classed as 30 g/tex or higher. The yields and quality of modern genetics is amazing. It is critical that growers make good decisions with respect to varieties. The Extension cotton crop management program is critical to this success. Incidentally, the Oklahoma-ginned bales classed at Abilene thus far from the 2013 crop have the highest average staple and strength averages. The Abilene classing office serves east Texas, a portion of west Texas, Oklahoma, and Kansas.

We are very appreciative of the contributions made by the OSU IPM Program. Without their support and participation, much of this work would not be possible. We also appreciate the support from producers and ginners, County Extension Educators, the Oklahoma Cooperative Extension Service, and the Oklahoma Agricultural Experiment Station. Cotton Incorporated, through the Oklahoma State Support Committee, has also provided assistance through partial funding of several projects. We also appreciate the assistance of the Oklahoma Cotton Council, because their continued support of our educational programs is critical to our success. A thank you is extended to the following entities, whose specific contributions make it possible to maintain and expand our research and demonstration programs and distribute results.

Cotton Incorporated
Americot/NexGen
Monsanto Company
Dow AgroSciences
Nichino America
Worrell Farms
BASF Corporation
Crop Production Services
DuPont
Winfield Solutions
Syngenta Crop Protection
Bayer CropScience
Cheminova, Inc.
Helena Chemical

We appreciate the interest, cooperation and support of all those involved in the cotton industry in Oklahoma and encourage your comments and suggestions for the improvement of our programs. This report can be accessed via the Internet at the following websites: www.cotton.okstate.edu and www.ntokcotton.org.

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Greg Chavez, Field Assistant
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Lawrence Tomah, Harmon County
Ron Wright, Custer County
Glenn Detweiler, Washita County
Greg Hartman, Beckham County
David Nowlin, Caddo County
Travis Tacker, Kiowa County

Producers and Cooperators

Western Oklahoma State College
Danny Davis - Canute
Keeff Felty & Natalie Wheeler - Altus
Roger Fischer - Frederick
Tony Cox – Wellington, TX
Kelly Horton – Hollis
Greg Strawn - Eldorado
Humphreys Co-operative, Altus-Tipton
Cotton Growers Co-op, Altus
John McCullough - Tipton
Merlin Schantz - Hydro
Mark Anderson – Snyder
Harvey Schroeder - Oklahoma Cotton Council
Jack and Jake Damron - Delhi

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Variety Performance

2013 Extension Cotton On-Farm Variety Testing

Extension large-plot on-farm replicated cotton variety trials are an important component in modern germplasm evaluation. Producer-cooperator and industry support for these trials is substantial. These trials enable growers to observe the newest genetics and transgenic traits on their operations, under their management conditions and are planted and harvested with their equipment. Multiple sites have provided excellent information on which growers can base important variety selection decisions. The objective of this project was to evaluate multiple cotton varieties in producer-cooperator fields under irrigated and dryland management systems.

Six large-plot trials were planted and harvested using grower equipment. The testing locations were Custer, Harmon, Tillman, Jackson, Beckham and Washita Counties. Most trials were established under no-till or strip-till conditions. For the Replicated Agronomic Cotton Evaluation (RACE) trials, typically 6-8 entries (one entry per brand name, plus a grower choice option) were planted at each site, with 3 replicates used. The Cotton Incorporated Core program provided direct support for two trials, the Enhanced Variety Trials, which contained up to 10 entries and 3 replicates (Custer and Harmon Counties). A West Texas Lee weigh wagon (for boll buggies) or Western Forage Systems platform scale (for round modules) was utilized to capture plot weights. At harvest, grab samples were taken from each plot and ginned at the Texas A&M AgriLife Research and Extension Center at Lubbock. Fiber samples were submitted to the Texas Tech University Fiber and Biopolymer Research Institute for high volume instrument (HVI) analysis. Color and leaf grades were set to 21 and 2, respectively, for each sample. HVI data were used to compute the Commodity Credit Corporation (CCC) Loan value for each sample. Final plant heights and visual estimates of storm resistance were taken prior to harvest.

Replicated trials are used in order to obtain multiple independent observations of each variety's performance in comparison with other entries. Statistical analyses of each characteristic reported are represented by "protected" LSD (least significant difference) values given at the bottom of each column in the table. If the difference between the characteristic of concern (i.e. yield, lint turnout, staple, etc) of any two varieties exceeds the LSD (0.05) value provided, then the chances are approximately 95 out of 100 that the difference is real and not a result of other factors such as random error.

The data indicated that in spite of the continuing severe drought situation in far southwestern counties, irrigated cotton performed very well in 2013. This can be attributed to some timely precipitation and cooler temperatures in July and September cotton heat unit accumulation that was about 30% above normal (see appendix for temperatures).

Cultural practices and other information for each site are provided in Table 1. Data summaries for each location are provided in Tables 2-13. Summaries across locations for several important characteristics are provided in Tables 14-22.

Mean lint yields at all irrigated sites exceeded 3 bales/acre, and one site averaged above 4 bales/acre. The single dryland location averaged about 600 lbs/acre. Lint yields from on-farm irrigated trial yields were generally a function of available water and delivery efficiency in these fields, but timely rainfall assisted in producing exceptional yields at some sites. Test average yields ranged from a low of 1570 lb/acre in a furrow irrigated trial to over 2100 lb/acre in a center pivot trial.

Net value/acre in this report is defined as lint loan value on a per acre basis plus seed value, which equals total potential income/acre. Total potential income/acre minus ginning cost/acre and seed and technology fees/acre then defines net value/acre. Net value/acre averaged \$1134/acre across all irrigated sites and ranged from a low of \$967 to a high of \$1362. Within site differences were most expressed at the Custer County location. When comparing the top and bottom producing entries, a difference of about \$600/acre could be attributed to variety selection in this field in 2013. When the four common entries across all locations were compared, it is evident that the Stoneville 4946GLB2 entry was very competitive with PhytoGen 499WRF and NexGen 1511B2RF. Across the 5 sites, the FiberMax 1944GLB2 was about \$100/acre less competitive than the Stoneville 4946GLB2.

Another important attribute producers should consider include storm resistance. Storm resistance ratings were visually scored just prior to harvest. These ratings range from 1 (bolls loose, with considerable seedcotton loss) to 9 (bolls very tight, with no seedcotton loss). The degree of storm tolerance that a grower can accept can vary from one operation to another. The most important consideration is to be aware of the storm tolerance of varieties planted. This is a major component of risk management.

Plant height is another varietal characteristic that producers should investigate. The plant heights provided were measured near the end of the growing season, prior to harvest aid applications. Excessive rainfall and/or irrigation coupled with high nitrogen fertility can result in varieties producing large plants in spite of high doses of mepiquat based plant growth regulators.

Fiber quality among entries was generally good to excellent unless maturity or late season stress (on dryland) was encountered. The HVI data include several important fiber property measurements. Fiber length (staple when expressed as 32nds), micronaire, strength, and uniformity are the fiber properties reported which partially determine the price per pound for lint. Fiber length was measured as the upper half mean (in inches). Those measurements were also converted into 32nds to determine staple. Uniformity was obtained by dividing mean length (also measured in inches) by the upper half mean length and expressing the result as a percentage. Micronaire is actually a confounded measurement of both fiber fineness and maturity. Micronaire was measured in standard micronaire units. Fiber strength was measured in grams-force per tex on a “beard of fibers” during HVI analysis.

Higher values for lint yield, lint turnout, staple, strength, and uniformity are generally more desirable than lower ones. Micronaire is acceptable anywhere within the micronaire “base” range of 3.5 to 4.9 inclusive. The “premium” range is between 3.7 and 4.2 inclusive. If micronaire falls in the “discount” range (below 3.5 or above 4.9), the price per pound of lint is reduced. Penalties tend to be more severe for micronaire values below 3.5 (especially below

3.0) than for those above 4.9. Therefore, producers should probably select varieties with micronaire values toward the upper half of the range, rather than the lower.

The results from these trials indicate that variety selection in 2013 was very important at some sites. Differences in yields (lb/acre) between highest and lowest lint producers were 910, 236, 139, 245, and 525 among irrigated sites. This difference was 167 lb/acre for the dryland site.

ACKNOWLEDGEMENTS

The authors thank our cooperators: Merlin Schantz, Tony Cox, John McCullough, Drew Darby, Jack Damron, and Danny Davis. We also thank Dr. Mark Kelley and Rhett Overman for sample ginning, and the TTU-FBRI personnel for timely assistance with HVI analysis.

Table 1. 2013 Cultural information for Extension large plot trial sites.

	Irrigated Cotton Inc Enhanced Variety		Irrigated RACE			Dryland RACE
County-location	Custer - Hydro	Harmon - Hollis	Tillman - Tipton	Jackson - Duke	Beckham - Delhi	Washita - Elk City
Cooperator	Merlin Schantz	Tony Cox	John McCullough	Drew Darby	Jack Damron	Danny Davis
Tillage system	strip till	minimum till	conventional till	conventional till	strip till	no-till
Planting date	21-May	17-May	23-May	16-May	10-May	4-Jun
Seeding rate	49,000	50,000	37,250	47,000	35,000	30,000
Row spacing	36 inches	40 inches	40 inches	40 inches	40 inches	40 inches
Replicates	3	3	3	3	3	3
Harvested plot width	8 rows	6 rows	4 rows	4 rows	4 rows	6 rows
Harvested plot length	600 ft	1300 ft	1000 ft	750 ft	525 ft	1100 ft
Harvest date	3-Dec	4-Nov	1-Nov	14-Nov	9-Nov	2-Dec
Comments	pivot irrigation	subsurface drip irrigation 10% defoliation by hail on August 16	furrow irrigation	furrow irrigation	pivot irrigation	good early season, late stress
Harvester type	stripper with field cleaner	picker	stripper with field cleaner	stripper with field cleaner	stripper with field cleaner	stripper with field cleaner
Entries	FM 1944GLB2	FM 1944GLB2	FM 1944GLB2	FM 1944GLB2	FM 1944GLB2	FM 1944GLB2
	ST 4946GLB2	ST 4946GLB2	ST 4946GLB2	ST 4946GLB2	ST 4946GLB2	ST 4946GLB2
	PHY 499WRF	PHY 499WRF	PHY 499WRF	PHY 499WRF	PHY 499WRF	PHY 499WRF
	CG 3787B2RF	CG 3787B2RF	CG 3156B2RF	CG 3787B2RF	CG 3787B2RF	CG 3156B2RF
	NG 1511B2RF	NG 1511B2RF	NG 1511B2RF	NG 1511B2RF	NG 1511B2RF	NG 1511B2RF
	DP 1044B2RF	DP 1359B2RF	DP 1044B2RF	DP 1044B2RF	DP 1219B2RF	DP 1044B2RF
	DP 0912B2RF	DP 1219B2RF				
	DG 2570B2RF	DP 1044B2RF				
Grower's choice	DP 1219B2RF	none	none	DP 1359B2RF	none	DP 1137B2RF

Table 2. Harvest results from the Beckham County irrigated RACE trial, Jack Damron Farm, Delhi, OK, 2013.

Entry	Lint turnout	Seed turnout	Bur cotton yield	Lint yield	Seed yield	Lint loan value	Lint value	Seed value	Total value	Ginning cost	Seed/tech cost	Net value	
	---------- % ----------		----------- lb/acre -----------			--$/lb--	--------------------------- $/acre -----------------------------						
Croplan Genetics 3787B2RF	34.1	49.3	6684	2278	3293	0.5798	1321	379	1699	201	50	1448	a
Stoneville 4946GLB2	33.1	53.2	6638	2190	3531	0.5817	1274	406	1680	199	53	1428	a
NexGen 1511B2RF	34.0	49.2	6542	2224	3218	0.5810	1292	370	1662	196	47	1419	a
PhytoGen 499WRF	34.2	51.0	6334	2166	3229	0.5812	1259	371	1630	190	49	1391	a
Deltapine 1219B2RF	31.6	50.6	6651	2103	3361	0.5810	1222	387	1608	200	49	1360	a
FiberMax 1944GLB2	29.3	50.1	5979	1753	2994	0.5800	1017	344	1361	179	53	1128	b
Test average	32.7	50.6	6471	2119	3271	0.5808	1231	376	1607	194	50	1362	
CV, %	2.1	2.6	4.4	4.5	4.5	0.1	4.5	4.5	4.5	4.4	--	4.6	
OSL	<0.0001	0.0355	0.0850	0.0006	0.0219	0.0357	0.0006	0.0219	0.0018	0.0850	--	0.0010	
LSD	1.3	2.4	425†	173	266	0.0012	100	31	131	13†	--	115	

For net value/acre, means within a column with the same letter are not significantly different.
CV - coefficient of variation.
OSL - observed significance level, or probability of a greater F value.
LSD - least significant difference at the 0.05 level, † indicates significance at the 0.10 level, NS - not significant.
Note: some columns may not add up due to rounding error.

Assumes:
$3.00/cwt ginning cost.
$230/ton for seed.
Value for lint based on CCC loan value from grab samples and FBRI HVI results.
Color grades set to 21, leaf grades set to 2 for entire trial.

Table 3. Harvest results from the Beckham County irrigated RACE trial, Jack Damron Farm, Delhi, OK, 2013.

Entry	Final population	Final plant height	Storm resistance	Micronaire	Staple	Strength	Uniformity
	plants/acre	inches	1-9 visual scale*	units	32nds inch	g/tex	%
Croplan Genetics 3787B2RF	25,352	35.2	4.2	4.0	37.3	29.6	81.8
Deltapine 1219B2RF	29,359	38.8	6.2	3.7	38.2	32.9	80.9
FiberMax 1944GLB2	28,140	30.2	6.2	3.8	38.2	30.6	80.7
NexGen 1511B2RF	27,791	31.9	4.8	4.0	36.3	31.6	81.6
PhytoGen 499WRF	27,356	40.0	5.5	4.0	37.1	31.6	81.5
Stoneville 4946GLB2	27,356	32.2	7.2	4.0	37.3	32.0	81.4
Test average	27,559	34.7	5.7	3.9	37.4	31.4	81.3
CV, %	6.2	10.6	5.6	2.8	1.4	1.7	0.7
OSL	0.2083	0.0427	<0.0001	0.011	0.0077	0.0005	0.2208
LSD	NS	6.7	0.6	0.2	0.9	1.0	NS

CV - coefficient of variation.

OSL - observed significance level, or probability of a greater F value.

LSD - least significant difference at the 0.05 level, † indicates significance at the 0.10 level, NS - not significant.

*Visual storm resistance scale: 1=loose, 9=tight.

Assumes:

Color grades set to 21, leaf grades set to 2 for entire trial.

Table 4. Harvest results from the Jackson County irrigated RACE trial, Drew Darby Farm, Duke, OK, 2013.

Entry	Lint turnout	Seed turnout	Bur cotton yield	Lint yield	Seed yield	Lint loan value	Lint value	Seed value	Total value	Ginning cost	Seed/tech cost	Net value	
	---------- % ----------		----------- lb/acre -----------			--$/lb--	--------------------------- $/acre -----------------------------						
PhytoGen 499WRF	35.7	49.2	4767	1701	2344	0.5785	984	270	1254	143	66	1044	a
Grower's Choice Deltapine 1359B2RF	34.8	52.3	4774	1660	2496	0.5777	959	287	1246	143	72	1031	ab
Deltapine 1044B2RF	33.2	51.7	4716	1567	2437	0.5770	904	280	1184	141	65	978	abc
NexGen 1511B2RF	36.7	50.0	4371	1606	2186	0.5623	904	251	1156	131	63	962	bc
Stoneville 4946GLB2	34.2	52.9	4418	1510	2336	0.5803	876	269	1145	133	72	941	c
Croplan Genetics 3787B2RF	36.4	50.8	4094	1489	2078	0.5790	862	239	1101	123	68	911	c
FiberMax 1944GLB2	34.1	52.5	4270	1456	2243	0.5788	843	258	1100	128	72	901	c
Test average	35.0	51.3	4487	1570	2303	0.5762	905	265	1169	135	68	967	
CV, %	3.5	2.9	4.3	4.4	4.3	1.2	4.5	4.3	4.4	4.3	--	4.8	
OSL	0.0318	0.0696	0.0049	0.0077	0.0033	0.1018	0.0106	0.0032	0.0142	0.0049	--	0.0142	
LSD	2.1	2.1†	345	124	176	NS	72	20	92	10	--	82	

For net value/acre, means within a column with the same letter are not significantly different.
CV - coefficient of variation.
OSL - observed significance level, or probability of a greater F value.
LSD - least significant difference at the 0.05 level, † indicates significance at the 0.10 level, NS - not significant.
Note: some columns may not add up due to rounding error.

Assumes:
$3.00/cwt ginning cost.
$230/ton for seed.
Value for lint based on CCC loan value from grab samples and FBRI HVI results.
Color grades set to 21, leaf grades set to 2 for entire trial.

Table 5. Harvest results from the Jackson County irrigated RACE trial, Drew Darby Farm, Duke, OK, 2013.

Entry	Final population	Final plant height	Storm resistance	Micronaire	Staple	Strength	Uniformity
	plants/acre	inches	1-9 visual scale*	units	32nds inch	g/tex	%
Croplan Genetics 3787B2RF	33,541	27.8	4.3	4.4	37.1	29.7	82.0
Deltapine 1044B2RF	40,685	24.9	6.2	4.5	35.8	30.1	81.4
FiberMax 1944GLB2	33,977	24.4	6.7	4.5	37.0	30.3	81.2
Grower's Choice Deltapine 1359B2RF	35,632	28.7	3.7	4.2	37.1	30.6	79.7
NexGen 1511B2RF	39,204	25.4	4.2	4.7	35.0	30.5	81.5
PhytoGen 499WRF	35,371	29.5	5.2	4.6	36.0	31.7	82.5
Stoneville 4946GLB2	35,458	22.8	7.2	4.6	36.9	32.3	82.4
Test average	36,267	26.2	5.3	4.5	36.4	30.7	81.5
CV, %	6.2	9.1	6.0	3.9	1.5	2.5	0.7
OSL	0.0163	0.0400	<0.0001	0.0497	0.0023	0.0163	0.0017
LSD	4,000	4.2	0.6	0.3	1.0	1.4	1.1

CV - coefficient of variation.

OSL - observed significance level, or probability of a greater F value.

LSD - least significant difference at the 0.05 level, † indicates significance at the 0.10 level, NS - not significant.

*Visual storm resistance scale: 1=loose, 9=tight.

Assumes:

Color grades set to 21, leaf grades set to 2 for entire trial.

Table 6. Harvest results from the Tillman County irrigated RACE trial, John McCullough Farm, Tipton, OK, 2013.

Entry	Lint turnout	Seed turnout	Bur cotton yield	Lint yield	Seed yield	Lint loan value	Lint value	Seed value	Total value	Ginning cost	Seed/tech cost	Net value	
	---------- % ----------		----------- lb/acre -----------			--$/lb--	---------------------------- $/acre ------------------------------						
PhytoGen 499WRF	32.7	47.9	5981	1954	2866	0.5743	1123	330	1453	179	53	1221	a
Stoneville 4946GLB2	30.0	47.4	6488	1944	3074	0.5738	1115	353	1469	195	57	1217	a
FiberMax 1944GLB2	32.2	48.8	5898	1900	2879	0.5722	1089	331	1420	177	57	1186	a
Deltapine 1044B2RF	28.4	49.8	6392	1815	3181	0.5752	1043	366	1409	192	52	1166	a
Croplan Genetics 3156B2RF	29.0	45.6	6540	1895	2983	0.5652	1071	343	1414	196	52	1166	a
NexGen 1511B2RF	32.1	45.7	5900	1893	2696	0.5600	1062	310	1372	177	50	1145	a
Test average	30.7	47.5	6200	1900	2947	0.5701	1084	339	1423	186	53	1183	
CV, %	6.5	6.5	6.3	6.3	6.5	1.9	6.8	6.5	6.6	6.3	--	7.0	
OSL	0.0973	0.5280	0.1968	0.7552	0.1107	0.4856	0.7422	0.1109	0.8401	0.1963	--	0.8347	
LSD	2.9†	NS	NS	NS	NS	NS	NS	NS	NS	NS	--	NS	

For net value/acre, means within a column with the same letter are not significantly different.
CV - coefficient of variation.
OSL - observed significance level, or probability of a greater F value.
LSD - least significant difference at the 0.05 level, † indicates significance at the 0.10 level, NS - not significant.
Note: some columns may not add up due to rounding error.

Assumes:
$3.00/cwt ginning cost.
$230/ton for seed.
Value for lint based on CCC loan value from grab samples and FBRI HVI results.
Color grades set to 21, leaf grades set to 2 for entire trial.

Table 7. Harvest results from the Tillman County irrigated RACE trial, John McCullough Farm, Tipton, OK, 2013.

Entry	Final population	Final plant height	Storm resistance	Micronaire	Staple	Strength	Uniformity
	plants/acre	inches	1-9 visual scale*	units	32nds inch	g/tex	%
Croplan Genetics 3156B2RF	38,333	37.3	6.0	4.2	34.8	28.5	79.7
Deltapine 1044B2RF	33,541	39.7	7.0	4.2	35.9	30.5	81.2
FiberMax 1944GLB2	33,803	36.4	7.3	4.5	36.3	30.0	79.9
NexGen 1511B2RF	35,197	38.9	5.0	4.6	35.0	30.4	80.0
PhytoGen 499WRF	34,935	40.2	5.3	4.5	35.4	31.0	81.2
Stoneville 4946GLB2	36,678	38.9	6.0	4.5	36.1	30.7	80.6
Test average	35,414	38.6	6.1	4.4	35.6	30.2	80.5
CV, %	7.4	8.5	5.7	4.7	2.4	3.2	1.2
OSL	0.2952	0.7157	<0.0001	0.1002	0.2690	0.0953	0.3132
LSD	NS	NS	0.6	NS	NS	1.4†	NS

CV - coefficient of variation.

OSL - observed significance level, or probability of a greater F value.

LSD - least significant difference at the 0.05 level, † indicates significance at the 0.10 level, NS - not significant.

*Visual storm resistance scale: 1=loose, 9=tight.

Assumes:

Color grades set to 21, leaf grades set to 2 for entire trial.

Table 8. Harvest results from the Harmon County irrigated Cotton Incorporated Enhanced Variety trial, Tony Cox Farm, Hollis, OK, 2013.

Entry	Lint turnout	Seed turnout	Bur cotton yield	Lint yield	Seed yield	Lint loan value	Lint value	Seed value	Total value	Ginning cost	Seed/tech cost	Net value	
	---------- % ----------		----------- lb/acre -----------			--$/lb--	--------------------------- $/acre -----------------------------						
PhytoGen 499WRF	37.2	53.4	5143	1915	2745	0.5802	1111	316	1427	154	71	1202	a
NexGen 1511B2RF	36.9	50.9	5177	1912	2637	0.5783	1105	303	1409	155	67	1186	ab
Deltapine 1044B2RF	34.0	54.6	5356	1819	2924	0.5778	1051	336	1387	161	69	1157	abc
Stoneville 4946GLB2	34.7	55.0	5093	1769	2802	0.5803	1026	322	1349	153	76	1119	abcd
FiberMax 1740B2F	35.7	54.0	4898	1779	2689	0.5740	1021	309	1330	147	69	1115	abcd
FiberMax 1944GLB2	33.9	55.4	4853	1726	2825	0.5783	998	325	1323	146	76	1101	bcd
Deltapine 1219B2RF	35.0	54.3	4987	1743	2708	0.5732	999	311	1310	150	69	1091	cd
Croplan Genetics 3787B2RF	36.1	53.3	4786	1729	2552	0.5790	1001	294	1295	144	72	1079	cd
Deltapine 1359B2RF	34.4	54.3	4886	1679	2654	0.5708	959	305	1264	147	76	1041	d
Test average	35.3	53.9	5020	1786	2726	0.5769	1030	314	1344	151	72	1121	
CV, %	4.1	3.0	5.3	4.3	4.1	1.0	4.3	4.1	4.2	5.3	--	4.5	
OSL	0.0782	0.1117	0.2525	0.0165	0.0272	0.5084	0.0097	0.0273	0.0421	0.2527	--	0.0232	
LSD	2.0 †	NS	NS	132	192	NS	77	22	98	14	--	87	

For net value/acre, means within a column with the same letter are not significantly different.

CV - coefficient of variation.

OSL - observed significance level, or probability of a greater F value.

LSD - least significant difference at the 0.05 level, † indicates significance at the 0.10 level, NS - not significant.

Note: some columns may not add up due to rounding error.

Assumes:

$3.00/cwt ginning cost.

$230/ton for seed.

Value for lint based on CCC loan value from grab samples and FBRI HVI results.

Color grades set to 21, leaf grades set to 2 for entire trial.

Table 9. Harvest results from the Harmon County irrigated Cotton Incorporated Enhanced Variety trial, Tony Cox Farm, Hollis, OK, 2013.

Entry	Final population	Final plant height	Storm resistance	Micronaire	Staple	Strength	Uniformity
	plants/acre	inches	1-9 visual scale*	units	32nds inch	g/tex	%
Croplan Genetics 3787B2RF	35,283	36.4	4.3	4.0	36.8	28.9	81.6
Deltapine 1044B2RF	41,382	40.7	6.7	4.0	36.3	28.9	81.0
Deltapine 1219B2RF	33,977	43.3	5.3	3.5	38.2	31.7	80.4
Deltapine 1359B2RF	38,682	43.5	4.0	3.5	37.6	31.0	79.6
FiberMax 1740B2F	37,810	36.9	6.3	4.0	35.5	29.2	81.1
FiberMax 1944GLB2	33,019	42.1	5.7	3.9	38.0	29.5	80.7
NexGen 1511B2RF	37,462	41.6	4.3	4.3	36.3	30.6	81.8
PhytoGen 499WRF	39,117	40.5	5.7	4.3	36.5	30.4	81.6
Stoneville 4946GLB2	38,943	36.8	7.0	4.0	36.6	30.6	81.8
Test average	37,297	40.2	5.5	3.9	36.9	30.1	81.1
CV, %	10.8	8.0	8.2	3.1	1.3	2.2	0.9
OSL	0.2863	0.0705	<0.0001	<0.0001	<0.0001	0.0008	0.0327
LSD	NS	4.6 †	0.8	0.2	0.8	1.2	1.3

CV - coefficient of variation.

OSL - observed significance level, or probability of a greater F value.

LSD - least significant difference at the 0.05 level, † indicates significance at the 0.10 level, NS - not significant.

*Visual storm resistance scale: 1=loose, 9=tight.

Assumes:

Color grades set to 21, leaf grades set to 2 for entire trial.

Table 10. Harvest results from the Custer County irrigated Cotton Incorporated Enhanced Variety Trial, Merlin Schantz Farm, Hydro, OK, 2013.

Entry	Lint turnout	Seed turnout	Bur cotton yield	Lint yield	Seed yield	Lint loan value	Lint value	Seed value	Total value	Ginning cost	Seed/tech cost	Net value	
	---------- % ----------		----------- lb/acre -----------			--$/lb--	--------------------------- $/acre ------------------------------						
Deltapine 0912B2RF	28.3	51.4	7283	2063	3744	0.5265	1086	431	1517	218	72	1227	a
Stoneville 4946GLB2	29.0	53.7	6725	1950	3609	0.5190	1012	415	1427	202	72	1154	ab
FiberMax 1740B2F	28.1	51.6	6841	1923	3529	0.5175	995	406	1401	205	64	1131	bc
Dyna-Gro 2570B2RF	27.2	51.4	6879	1869	3534	0.5173	967	406	1373	206	70	1097	bcd
NexGen 1511B2RF	28.9	49.4	6487	1875	3203	0.5048	947	368	1315	195	63	1058	cd
FiberMax 1944GLB2	26.4	52.5	6548	1730	3441	0.5162	894	396	1289	196	72	1021	d
Croplan Genetics 3787B2RF	25.9	50.7	6167	1598	3128	0.4853	775	360	1135	185	68	882	e
PhytoGen 499WRF	26.6	48.2	5820	1548	2804	0.4983	771	322	1094	175	66	853	e
Deltapine 1044B2RF	24.1	51.1	6011	1447	3072	0.4842	701	353	1054	180	65	808	e
Grower's Choice Deltapine 1219B2RF	23.6	50.8	4875	1153	2475	0.4800	553	285	838	146	65	626	f
Test average	26.8	51.1	6364	1716	3254	0.5049	870	374	1244	191	68	986	
CV, %	5.5	1.4	2.7	2.6	2.7	3.4	5.2	2.7	4.3	2.7	--	5.0	
OSL	0.0022	<0.0001	<0.0001	<0.0001	<0.0001	0.0225	<0.0001	<0.0001	<0.0001	<0.0001	--	<0.0001	
LSD	2.5	1.3	296	78	151	0.0290	78	17	92	9	--	85	

For net value/acre, means within a column with the same letter are not significantly different.
CV - coefficient of variation.
OSL - observed significance level, or probability of a greater F value.
LSD - least significant difference at the 0.05 level, † indicates significance at the 0.10 level, NS - not significant.
Note: some columns may not add up due to rounding error.

Assumes:
$3.00/cwt ginning cost.
$230/ton for seed.
Value for lint based on CCC loan value from grab samples and FBRI HVI results.
Color grades set to 21, leaf grades set to 2 for entire trial.

Table 11. Harvest results from the Custer County irrigated Cotton Incorporated Enhanced Variety Trial, Merlin Schantz Farm, Hydro, OK, 2013.

Entry	Final population	Final plant height	Storm resistance	Micronaire	Staple	Strength	Uniformity
	plants/acre	inches	1-9 visual scale*	units	32nds inch	g/tex	%
Croplan Genetics 3787B2RF	34,461	42.9	4.2	2.5	39.5	29.5	81.1
Dyna-Gro 2570B2RF	31,557	39.7	5.3	2.8	38.7	30.1	81.3
Deltapine 0912B2RF	27,685	39.3	3.8	2.9	37.2	29.8	81.0
Deltapine 1044B2RF	32,912	42.9	5.7	2.4	37.9	30.1	80.5
FiberMax 1740B2F	27,491	38.2	4.7	2.8	38.5	30.9	81.4
FiberMax 1944GLB2	27,588	37.2	5.2	2.8	40.3	30.5	80.8
Grower's Choice Deltapine 1219B2RF	32,041	56.2	4.2	2.2	39.2	31.0	78.4
NexGen 1511B2RF	29,137	41.7	4.2	2.6	37.6	30.3	80.4
PhytoGen 499WRF	35,235	44.1	4.8	2.5	38.8	31.5	81.6
Stoneville 4946GLB2	32,622	38.1	6.3	2.7	39.1	31.6	81.0
Test average	31,073	42.0	4.8	2.6	38.7	30.5	80.7
CV, %	11.8	9.2	9.7	7.3	1.8	3.4	1.3
OSL	0.1202	0.0006	<0.0001	0.0042	0.0011	0.2509	0.0923
LSD	NS	6.7	0.8	0.3	1.2	NS	1.5 †

CV - coefficient of variation.

OSL - observed significance level, or probability of a greater F value.

LSD - least significant difference at the 0.05 level, † indicates significance at the 0.10 level, NS - not significant.

*Visual storm resistance scale: 1=loose, 9=tight.

Assumes:

Color grades set to 21, leaf grades set to 2 for entire trial.

Table 12. Harvest results from the Washita County dryland RACE trial, Danny Davis Farm, Elk City, OK, 2013.

Entry	Lint turnout	Seed turnout	Bur cotton yield	Lint yield	Seed yield	Lint loan value	Lint value	Seed value	Total value	Ginning cost	Seed/tech cost	Net value	
	---------- % ----------		----------- lb/acre -----------			--$/lb--	--------------------------- $/acre -----------------------------						
Stoneville 4946GLB2	36.3	48.7	1934	702	942	0.5337	375	108	483	58	46	379	a
NexGen 1511B2RF	36.6	46.4	1654	606	767	0.5405	328	88	416	50	40	326	b
FiberMax 1944GLB2	34.4	48.9	1601	551	783	0.5647	311	90	401	48	46	307	bc
Deltapine 1044B2RF	35.5	48.1	1685	597	810	0.4983	297	93	391	51	42	298	cd
Croplan Genetics 3156B2RF	35.5	47.1	1690	600	795	0.4978	299	91	390	51	42	297	cd
PhytoGen 499WRF	36.6	45.8	1568	574	718	0.5198	298	83	381	47	42	292	cd
Grower's Choice Deltapine 1137B2RF	35.4	49.2	1512	535	743	0.5272	282	85	367	45	44	278	d
Test average	35.7	47.7	1663	595	794	0.5260	313	91	404	50	43	311	
CV, %	3.4	1.4	3.2	3.2	3.2	2.5	3.5	3.2	3.2	3.2	--	3.8	
OSL	0.3599	0.0002	<0.0001	<0.0001	<0.0001	0.0005	<0.0001	<0.0001	<0.0001	<0.0001	--	<0.0001	
LSD	NS	1.2	95	34	45	0.0231	19	5	23	3	--	21	

For net value/acre, means within a column with the same letter are not significantly different.

CV - coefficient of variation.

OSL - observed significance level, or probability of a greater F value.

LSD - least significant difference at the 0.05 level, † indicates significance at the 0.10 level, NS - not significant.

Note: some columns may not add up due to rounding error.

Assumes:

$3.00/cwt ginning cost.

$230/ton for seed.

Value for lint based on CCC loan value from grab samples and FBRI HVI results.

Color grades set to 21, leaf grades set to 2 for entire trial.

Table 13. Harvest results from the Washita County dryland RACE trial, Danny Davis Farm, Elk City, OK, 2013.

Entry	Final population	Final plant height	Storm resistance	Micronaire	Staple	Strength	Uniformity
	plants/acre	inches	1-9 visual scale*	units	32nds inch	g/tex	%
Croplan Genetics 3156 B2RF	26,920	31.9	6.3	4.1	32.5	26.5	78.3
Deltapine 1044 B2RF	22,564	31.9	5.3	4.9	33.2	30.8	78.9
FiberMax 1944 GLB2	23,261	31.3	5.3	4.3	35.0	28.6	79.0
Grower's Choice Deltapine 1137 B2RF	24,742	35.3	4.0	4.3	33.2	28.9	80.4
NexGen 1511B2RF	21,867	32.9	3.8	4.7	33.6	31.1	79.5
PhytoGen 499WRF	23,871	38.9	2.7	4.6	32.9	31.6	79.8
Stoneville 4946GLB2	22,564	32.6	6.2	4.6	33.5	31.4	80.3
Test average	23,684	33.5	4.8	4.5	33.4	29.8	79.5
CV, %	10.8	5.4	9.4	3.4	1.6	2.2	1.0
OSL	0.3093	0.0028	<0.0001	0.0005	0.0038	<0.0001	0.0498
LSD	NS	3.2	0.8	0.3	1.0	1.1	1.4

CV - coefficient of variation.

OSL - observed significance level, or probability of a greater F value.

LSD - least significant difference at the 0.05 level, † indicates significance at the 0.10 level, NS - not significant.

*Visual storm resistance scale: 1=loose, 9=tight.

Assumes:

Color grades set to 21, leaf grades set to 2 for entire trial.

Table 14. Lint yield results from the Extension irrigated RACE trials, 2013.

County ==>	Beckham	Jackson	Tillman	Custer	Harmon	All-Site
Irrigation Type ==>	Pivot	Furrow	Furrow	Pivot	Drip	Mean
Location ==>	Delhi	Duke	Tipon	Hydro	Hollis	for Common
Cooperator ==>	Damron	Darby	McCullough	Schantz	Cox	Entries
Entry	-----------------------------	-----------------------------	Lint yield (lb/acre)	-----------------------------	-----------------------------	-----------------------------
Croplan Genetics 3787B2RF	2278	1489	--	1598	1729	
Deltapine 1219B2RF	2103	--	--	1153	1743	
FiberMax 1944GLB2	1753	1456	1900	1730	1726	1713
NexGen 1511B2RF	2224	1606	1893	1875	1912	1902
PhytoGen 499WRF	2166	1701	1954	1548	1915	1857
Stoneville 4946GLB2	2190	1510	1944	1950	1769	1873
Deltapine 1044B2RF	--	1567	1815	1447	1819	
Deltapine 1359B2RF	--	1660	--	--	1679	
Croplan Genetics 3156B2RF	--	--	1895	--	--	
Deltapine 0912B2RF	--	--	--	2063	--	
FiberMax 1740B2F	--	--	--	1923	1779	
Dyna-Gro 2570B2RF	--	--	--	1869		
Test average	2119	1570	1900	1716	1786	1836
CV, %	4.5	4.4	6.3	2.6	4.3	
OSL	0.0006	0.0077	0.7552	<0.0001	0.0165	
LSD	173	124	NS	78	132	

CV - coefficient of variation.
OSL - observed significance level, or probability of a greater F value.
LSD - least significant difference at the 0.05 level.

Table 15. Storm resistance results from the Extension irrigated RACE trials, 2013.

County ==>	Beckham	Jackson	Tillman	Custer	Harmon	All-Site
Irrigation Type ==>	Pivot	Furrow	Furrow	Pivot	Drip	Mean
Location ==>	Delhi	Duke	Tipon	Hydro	Hollis	for Common
Cooperator ==>	Damron	Darby	McCullough	Schantz	Cox	Entries
Entry	---------------------------------- Storm resistance (visual rating: 1 loose, 9 tight) --------------------------------------					
Croplan Genetics 3787B2RF	4.2	4.3	--	4.2	4.3	
Deltapine 1219B2RF	6.2	--	--	4.2	5.3	
FiberMax 1944GLB2	6.2	6.7	7.3	5.2	5.7	6.2
NexGen 1511B2RF	4.8	4.2	5.0	4.2	4.3	4.5
PhytoGen 499WRF	5.5	5.2	5.3	4.8	5.7	5.3
Stoneville 4946GLB2	7.2	7.2	6.0	6.3	7.0	6.7
Deltapine 1044B2RF	--	6.2	7.0	5.7	6.7	
Deltapine 1359B2RF	--	3.7	--	--	4.0	
Croplan Genetics 3156B2RF	--	--	6.0	--	--	
Deltapine 0912B2RF	--	--	--	3.8	--	
FiberMax 1740B2F	--	--	--	4.7	6.3	
Dyna-Gro 2570B2RF	--	--	--	5.3	--	
Test average	5.7	5.4	6.1	4.8	5.5	5.7
CV, %	5.6	6.0	5.7	9.7	8.2	
OSL	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	
LSD	0.6	0.6	0.6	0.8	0.8	

CV - coefficient of variation.

OSL - observed significance level, or probability of a greater F value.

LSD - least significant difference at the 0.05 level.

Table 16. Plant height results from the Extension irrigated RACE trials, 2013.

County ==>	Beckham	Jackson	Tillman	Custer	Harmon	All-Site
Irrigation Type ==>	Pivot	Furrow	Furrow	Pivot	Drip	Mean
Location ==>	Delhi	Duke	Tipon	Hydro	Hollis	for Common
Cooperator ==>	Damron	Darby	McCullough	Schantz	Cox	Entries
Entry	-------------------	-------------------	------------------- Plant height (inches)	-------------------	-------------------	-------------------
Croplan Genetics 3787B2RF	35.2	27.8	--	42.9	36.4	
Deltapine 1219B2RF	38.8	--	--	56.2	43.3	
FiberMax 1944GLB2	30.2	24.4	36.4	37.2	42.1	34.1
NexGen 1511B2RF	31.9	25.4	38.9	41.7	41.6	35.9
PhytoGen 499WRF	40.0	29.5	40.2	44.1	40.5	38.9
Stoneville 4946GLB2	32.2	22.8	38.9	38.1	36.8	33.8
Deltapine 1044B2RF	--	24.9	39.7	42.9	40.7	
Deltapine 1359B2RF	--	28.7	--	--	43.5	
Croplan Genetics 3156B2RF	--	--	37.3	--	--	
Deltapine 0912B2RF	--	--	--	39.3	--	
FiberMax 1740B2F	--	--	--	38.2	36.9	
Dyna-Gro 2570B2RF	--	--	--	39.7	--	
Test average	34.7	26.2	38.6	42.0	40.2	35.6
CV, %	10.6	9.1	8.5	9.2	8.0	
OSL	0.0427	0.0400	0.7157	0.0006	0.0705	
LSD	6.7	4.2	NS	6.7	4.6 †	

CV - coefficient of variation.

OSL - observed significance level, or probability of a greater F value.

LSD - least significant difference at the 0.05 level, † indicates significance at the 0.10 level, NS - not significant.

Table 17. Loan value results from the Extension irrigated RACE trials, 2013.

County ==> Irrigation Type ==> Location ==> Cooperator ==>	Beckham Pivot Delhi Damron	Jackson Furrow Duke Darby	Tillman Furrow Tipon McCullough	Custer Pivot Hydro Schantz	Harmon Drip Hollis Cox	All-Site Mean for Common Entries
Entry	---------- Loan value ($/lb) ----------					
Croplan Genetics 3787B2RF	0.5798	0.5790	--	0.4853	0.5790	
Deltapine 1219B2RF	0.5810	--	--	0.4800	0.5732	
FiberMax 1944GLB2	0.5800	0.5788	0.5722	0.5162	0.5783	0.5651
NexGen 1511B2RF	0.5810	0.5623	0.5600	0.5048	0.5783	0.5573
PhytoGen 499WRF	0.5812	0.5785	0.5743	0.4983	0.5802	0.5625
Stoneville 4946GLB2	0.5817	0.5803	0.5738	0.5190	0.5803	0.5670
Deltapine 1044B2RF	--	0.5770	0.5752	0.4842	0.5778	
Deltapine 1359B2RF	--	0.5777	--	--	0.5708	
Croplan Genetics 3156B2RF	--	--	0.5652	--	--	
Deltapine 0912B2RF	--	--	--	0.5265	--	
FiberMax 1740B2F	--	--	--	0.5175	0.5740	
Dyna-Gro 2570B2RF	--	--	--	0.5173	--	
Test average	0.5808	0.5762	0.5701	0.5049	0.5769	0.5630
CV, %	0.1	1.2	1.9	3.4	1.0	
OSL	0.0357	0.1018	0.4856	0.0225	0.5084	
LSD	0.0012	NS	NS	0.0290	NS	

CV - coefficient of variation.

OSL - observed significance level, or probability of a greater F value.

LSD - least significant difference at the 0.05 level, † indicates significance at the 0.10 level, NS - not significant.

Note: Color grades set to 21, leaf grades set to 2 for entire trial.

Table 18. Net value results from the Extension irrigated RACE trials, 2013.

County ==>	Beckham	Jackson	Tillman	Custer	Harmon	All-Site
Irrigation Type ==>	Pivot	Furrow	Furrow	Pivot	Drip	Mean
Location ==>	Delhi	Duke	Tipon	Hydro	Hollis	for Common
Cooperator ==>	Damron	Darby	McCullough	Schantz	Cox	Entries
Entry	-- Net value ($/acre) --					
Croplan Genetics 3787B2RF	1448	911	--	882	1079	
Deltapine 1219B2RF	1360	--	--	626	1091	
FiberMax 1944GLB2	1128	901	1186	1021	1101	1067
NexGen 1511B2RF	1419	962	1145	1058	1186	1154
PhytoGen 499WRF	1391	1044	1221	853	1202	1142
Stoneville 4946GLB2	1428	941	1217	1154	1119	1172
Deltapine 1044B2RF	--	978	1166	808	1157	
Deltapine 1359B2RF	--	1031	--	--	1041	
Croplan Genetics 3156B2RF	--	--	1166	--	--	
Deltapine 0912B2RF	--	--	--	1227	--	
FiberMax 1740B2F	--	--	--	1131	1115	
Dyna-Gro 2570B2RF	--	--	--	1097	--	
Test average	1362	967	1184	986	1121	1134
CV, %	4.6	4.8	7.0	5.0	4.5	
OSL	0.0010	0.0142	0.8347	<0.0001	0.0232	
LSD	115	82	NS	85	87	

CV - coefficient of variation.

OSL - observed significance level, or probability of a greater F value.

LSD - least significant difference at the 0.05 level, † indicates significance at the 0.10 level, NS - not significant.

Table 19. MIcronaire results from the Extension irrigated RACE trials, 2013.

County ==>	Beckham	Jackson	Tillman	Custer	Harmon	All-Site
Irrigation Type ==>	Pivot	Furrow	Furrow	Pivot	Drip	Mean
Location ==>	Delhi	Duke	Tipon	Hydro	Hollis	for Common
Cooperator ==>	Damron	Darby	McCullough	Schantz	Cox	Entries
Entry	---------- Micronaire (units) ----------					
Croplan Genetics 3787B2RF	4.0	4.4	--	2.5	4.0	
Deltapine 1219B2RF	3.7	--	--	2.2	3.5	
FiberMax 1944GLB2	3.8	4.5	4.5	2.8	3.9	3.9
NexGen 1511B2RF	4.0	4.7	4.6	2.6	4.3	4.0
PhytoGen 499WRF	4.0	4.6	4.5	2.5	4.3	4.0
Stoneville 4946GLB2	4.0	4.6	4.5	2.7	4.0	4.0
Deltapine 1044B2RF	--	4.5	4.2	2.4	4.0	
Deltapine 1359B2RF	--	4.2	--	--	3.5	
Croplan Genetics 3156B2RF	--	--	4.2	--	--	
Deltapine 0912B2RF	--	--	--	2.9	--	
FiberMax 1740B2F	--	--	--	2.8	4.0	
Dyna-Gro 2570B2RF	--	--	--	2.8	--	
Test average	3.9	4.5	4.4	2.6	3.9	4.0
CV, %	2.8	3.9	4.7	7.3	3.1	
OSL	0.011	0.0497	0.1002	0.0042	<0.0001	
LSD	0.2	0.3	NS	0.3	0.2	

CV - coefficient of variation.

OSL - observed significance level, or probability of a greater F value.

LSD - least significant difference at the 0.05 level, † indicates significance at the 0.10 level, NS - not significant.

Table 20. Staple results from the Extension irrigated RACE trials, 2013.

County ==>	Beckham	Jackson	Tillman	Custer	Harmon	All-Site
Irrigation Type ==>	Pivot	Furrow	Furrow	Pivot	Drip	Mean
Location ==>	Delhi	Duke	Tipon	Hydro	Hollis	for Common
Cooperator ==>	Damron	Darby	McCullough	Schantz	Cox	Entries
Entry	----------	----------	---------- Staple (32nds inch)	----------	----------	----------
Croplan Genetics 3787B2RF	37.3	37.1	--	39.5	36.8	
Deltapine 1219B2RF	38.2	--	--	39.2	38.2	
FiberMax 1944GLB2	38.2	37.0	36.3	40.3	38.0	38.0
NexGen 1511B2RF	36.3	35.0	35.0	37.6	36.3	36.0
PhytoGen 499WRF	37.1	36.0	35.4	38.8	36.5	36.8
Stoneville 4946GLB2	37.3	36.9	36.1	39.1	36.6	37.2
Deltapine 1044B2RF	--	35.8	35.9	37.9	36.3	
Deltapine 1359B2RF	--	37.1	--	--	37.6	
Croplan Genetics 3156B2RF	--	--	34.8	--	--	
Deltapine 0912B2RF	--	--	--	37.2	--	
FiberMax 1740B2F	--	--	--	38.5	35.5	
Dyna-Gro 2570B2RF	--	--	--	38.7	--	
Test average	37.4	36.4	35.6	38.7	36.9	37.0
CV, %	1.4	1.5	2.4	1.8	1.3	
OSL	0.0077	0.0023	0.2690	0.0011	<0.0001	
LSD	0.9	1.0	NS	1.2	0.8	

CV - coefficient of variation.

OSL - observed significance level, or probability of a greater F value.

LSD - least significant difference at the 0.05 level, † indicates significance at the 0.10 level, NS - not significant.

Table 21. Strength results from the Extension irrigated RACE trials, 2013.

County ==>	Beckham	Jackson	Tillman	Custer	Harmon	All-Site
Irrigation Type ==>	Pivot	Furrow	Furrow	Pivot	Drip	Mean
Location ==>	Delhi	Duke	Tipon	Hydro	Hollis	for Common
Cooperator ==>	Damron	Darby	McCullough	Schantz	Cox	Entries
Entry	----------	----------	---------- Strength (g/tex)	----------	----------	----------
Croplan Genetics 3787B2RF	29.6	29.7	--	29.5	28.9	
Deltapine 1219B2RF	32.9	--	--	31.0	31.7	
FiberMax 1944GLB2	30.6	30.3	30.0	30.5	29.5	30.2
NexGen 1511B2RF	31.6	30.5	30.4	30.3	30.6	30.7
PhytoGen 499WRF	31.6	31.7	31.0	31.5	30.4	31.2
Stoneville 4946GLB2	32.0	32.3	30.7	31.6	30.6	31.4
Deltapine 1044B2RF	--	30.1	30.5	30.1	28.9	
Deltapine 1359B2RF	--	30.6	--	--	31.0	
Croplan Genetics 3156B2RF	--	--	28.5	--	--	
Deltapine 0912B2RF	--	--	--	29.8	--	
FiberMax 1740B2F	--	--	--	30.9	29.2	
Dyna-Gro 2570B2RF	--	--	--	30.1	--	
Test average	31.4	30.7	30.2	30.5	30.1	30.9
CV, %	1.7	2.5	3.2	3.4	2.2	
OSL	0.0005	0.0163	0.0953	0.2509	0.0008	
LSD	1.0	1.4	1.4†	NS	1.2	

CV - coefficient of variation.

OSL - observed significance level, or probability of a greater F value.

LSD - least significant difference at the 0.05 level, † indicates significance at the 0.10 level, NS - not significant.

Table 22. Uniformity results from the Extension irrigated RACE trials, 2013.

County ==>	Beckham	Jackson	Tillman	Custer	Harmon	All-Site
Irrigation Type ==>	Pivot	Furrow	Furrow	Pivot	Drip	Mean
Location ==>	Delhi	Duke	Tipon	Hydro	Hollis	for Common
Cooperator ==>	Damron	Darby	McCullough	Schantz	Cox	Entries
Entry	------------------------------- Uniformity (%) -------------------------------					
Croplan Genetics 3787B2RF	81.8	82.0	--	81.1	81.6	
Deltapine 1219B2RF	80.9	--	--	78.4	80.4	
FiberMax 1944GLB2	80.7	81.2	79.9	80.8	80.7	80.7
NexGen 1511B2RF	81.6	81.5	80.0	80.4	81.8	81.1
PhytoGen 499WRF	81.5	82.5	81.2	81.6	81.6	81.7
Stoneville 4946GLB2	81.4	82.4	80.6	81.0	81.8	81.4
Deltapine 1044B2RF	--	81.4	81.2	80.5	81.0	
Deltapine 1359B2RF	--	79.7	--	--	79.6	
Croplan Genetics 3156B2RF	--	--	79.7	--	--	
Deltapine 0912B2RF	--	--	--	81.0	--	
FiberMax 1740B2F	--	--	--	81.4	81.1	
Dyna-Gro 2570B2RF	--	--	--	81.3	--	
Test average	81.3	81.5	80.4	80.8	81.1	81.2
CV, %	0.7	0.7	1.2	1.3	0.9	
OSL	0.2208	0.0017	0.3132	0.0923	0.0327	
LSD	NS	1.1	NS	1.5 †	1.3	

CV - coefficient of variation.

OSL - observed significance level, or probability of a greater F value.

LSD - least significant difference at the 0.05 level, † indicates significance at the 0.10 level, NS - not significant.

OSU Cotton Official Variety Tests - 2013

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Caddo Research Station, Fort Cobb

The Experiment Station cotton official variety tests (OVTs) were planted at the Southwest Research and Extension Center at Altus Center (SWREC) (furrow irrigated), Southwest Agronomy Research Station at Tipton (dryland), and Caddo Research Station at Fort Cobb (center pivot irrigated) in 2012 and 2013. Since the SWREC is located within Lugert-Altus Irrigation District, no irrigation was available in 2013 and the trials there failed. The Tipton dryland location failed due to drought in 2013.

The Fort Cobb site is classified as a Binger fine sandy loam, 1 to 3 percent slopes. The taxonomic classification is: Fine-loamy, mixed, active, thermic Udic Rhodustalfs. The trial consisted of 4 replicates of entries in both 2012 and 2013. Plot size was four 40-inch rows wide by 30 ft in length in 2012. In 2013, row spacing was changed to 36 inches, and plots were four rows wide by 30 ft in length. Harvested area was the center two rows by the length of the plot.

Fort Cobb 2013 OVT results can be found in Tables 1 and 2.

2012 Methodology Change

It should be noted that the methodology for the OVT program was changed in 2012 as compared to previous years. **This methodology is similar to other experiment station stripper harvested OVT locations such as Dr. Jane Dever's Texas A&M AgriLife Research program at Lubbock. At harvest, grab samples were taken from each plot in 3 of the 4 replicates. These grab samples were used to determine the lint and seed turnout for each individual entry and were used to convert plot bur cotton weights to lint per acre. Lint from these grab samples was submitted to the Texas Tech University Fiber and Biopolymer Research Institute to obtain high volume instrument (HVI) data.** Additionally, 50-boll samples were taken from each plot in 3 of the 4 replicates and other data (including boll sample lint fractions, boll size, seed index, lint index, and seed per boll) were derived from those. Additional collected data included a visual estimate of storm resistance, which is important in our area.

Understanding the Statistics Presented

Replicated trials are used in order to obtain multiple independent observations of each variety's performance in comparison with other entries. Statistical analyses of each characteristic reported are represented by "protected" LSD (least significant difference) values given at the bottom of each column in the table. If the difference between the characteristic of concern (i.e.

yield, lint turnout, fiber length, etc) of any two varieties exceeds the LSD (0.05) value provided, then the chances are approximately 95 out of 100 that the difference is real and not a result of other factors such as random error.

Lint Yield

Yield potential is probably the single most important agronomic characteristic, because pounds do drive profitability and provides for the safety net of higher crop insurance actual production history (APH) in case of catastrophic loss of acres. The benefit this can provide from the crop insurance perspective is important in our high risk area. Yield stability across environments is going to be important, and basically what we want to identify is a variety that has the ability to provide high yield across varying water inputs.

Lint Percentages

Lint percentage (sometimes called "gin turnout" or "lint turnout") influences ginning costs. As mentioned above, a change in methodology in 2012. Since we harvest our plots with a modified stripper, grab sample turnouts are the closest estimate of lint turnout. The fiber from these grab samples also provides the closest estimates of overall fiber quality. Historically, many states have use 50-boll samples to derive these estimates. However, most of these states use picker harvesters in their variety testing programs. Lint percentages from 50-boll boll samples are reported on both a picked and a pulled basis. Picked lint percentage was calculated as the fraction of lint in a sample of seedcotton, while pulled lint percentage was calculated as the fraction of lint in a sample of "snapped" cotton – which includes the bur. Producers who harvest with mechanical pickers should examine picked lint percentages, while those who harvest with strippers should compare pulled lint percentages. As the price received for gin-run cottonseed increases, the importance of a high lint percentage decreases. In addition, a variety with high lint yield per acre (but with a moderate lint percentage) often gives higher net returns per acre than does a lower yielding variety with a higher lint percentage. Differences in lint yield are considerably more important to net returns than are differences in lint percentage.

Fiber Properties Measured and Their Importance

The classification of U.S. cotton is dependent upon HVI analyses.[1] Lint from ginned grab samples was submitted to the Texas Tech University Fiber and Biopolymer Research Institute to obtain HVI data. The HVI data include several important fiber property measurements. Fiber length, micronaire, and strength are the fiber properties reported here which partially determine the price per pound for lint. While uniformity and elongation are important in the manufacturing process, at present, little or no price incentives are received by producers for either. Fiber length was measured as the upper half mean (in inches). Those measurements were also converted into 32's. Uniformity ratios were obtained by dividing mean length (also measured in inches) by the upper half mean length and expressing the result as a percentage. Micronaire is actually a confounded measurement of both fiber fineness and maturity. Micronaire was measured in standard micronaire units. Fiber strength was measured in grams-force per tex on a "beard of fibers" during HVI analysis. The same "fiber beard" is used to determine elongation (or "stretch") prior to breaking. This measurement was estimated as a percentage of its length prior to breaking. Percentage reflectance (rd) and yellowness (+b) are both components of HVI color grade and are used in its determination. Since color grade is not a quantitative variable, the average reflectance and +b are provided. Higher rd values and lower +b values are desired. In general, the more highly weathered cotton fiber becomes, lower rd values but higher +b values are observed.

Higher values for lint yield, the lint percentages, fiber length, uniformity ratio, fiber strength, elongation, and reflectance are generally more desirable than lower ones. Micronaire is acceptable anywhere within the micronaire "base" range of 3.5 to 4.9 inclusive. The "premium" range is between 3.7 and 4.2 inclusive. If micronaire falls in the "discount" range (below 3.5 or above 4.9), the price per pound of lint is reduced. Penalties tend to be more severe for micronaire values below 3.5 (especially below 3.0) than for those above 4.9. Therefore, producers should probably select varieties with micronaire values toward the upper half of the range, rather than the lower.

In recent years, the demand from international markets for cotton with high fiber quality has forced producers to pay more attention to the quality of fiber they produce. A large percentage of Oklahoma's cotton crop is exported. Therefore, fiber quality must become increasingly important to Oklahoma producers. The general recommendations include "31 color or better; 3 leaf grade or better; 35 staple (1.08-1.10 inches) or better; length uniformity of 81% or higher; 26 grams/tex or stronger and mid-range micronaire of 4.1 to 4.6."[2] When coupled with other critical management components, including proper harvesting and ginning techniques, many of today's cotton varieties can meet or exceed these criteria.

Other Agronomic Measurements Reported

These additional measurements are useful to better describe the characteristics of varieties planted.

Boll Size - Weight, in grams, of seedcotton per boll.

Seed Index - Weight, in grams, of 100 fuzzy seed.

Lint Index - Weight, in grams, of lint from 100 seed (calculated).

Seed Per Boll - Average number of seed per boll (calculated).

Storm Resistance - Visual estimate rating from 1 (very loose boll type, considerable seed cotton loss) to 9 (very tight boll type, no seed cotton loss).

References

[1] The Classification of Cotton. Agricultural Handbook 566. 2001. Cotton Program, Agricultural Marketing Service, U.S. Department of Agriculture. Wash. D.C.

[2] US Fiber Advantages, Cotton Grower Plus, November 2004, p. 17-18, 20; see also Estur, G. 2004. Quality Requirements on Export Markets for U.S. Cotton. In Proc. Beltwide Cotton Conf., San Antonio, TX. 5-9 Jan. 2004. Natl. Cotton Counc. Am., Memphis, TN. (Also available at http://www.icac.org/cotton_info/speeches/estur/2004/quality_reqs_us_exp.pdf .)

Site Information and Cultural Practices

Soil Test: pH: 7.7 Surface N: 2 P: 28 K: 194 Ca: 1807 Mg: 174 Fe: 18.7 Zn: 0.98 B: 0.31 Cu: 1.27, Subsoil: pH: 7.0 N: 5

4/15	Glyphos @ 1 qt. + Barrage @ 1.5 pt. + Induce @ 3 oz. (terminated wheat cover)
4/24	450 lb/acre 140-40-50
5/6	Glyphos @ 1 qt. + Induce @ 3 oz.
5/23	No-till planted into residue / Prowl H2O @ 1 qt. + Round-Up Power Max @ 1 qt. + 17 lb. AMS/100 gal. water
6/3	Orthene @ 2.3 oz.
6/7	Roundup Power Max @ 1 qt. + Orthene @ 4 oz.
6/27	Vydate @ 8 oz.
6/27	Roundup Power Max @ 1 qt. + Medal @ 1.33 pt.
7/8	Roundup Power Max @ 1 qt.
7/12	Mepiquat chloride PGR @ 8 oz.
7/23	Mepiquat chloride PGR @ 8 oz.
8/2	Mepiquat chloride PGR @ 16 oz.
10/16	Prep 42 oz + Ginstar 12 oz
11/7	Paraquat 32 oz + 0.5% NIS
11/17	Storm resistance ratings, and boll sampling
11/18	Stripped with JD 482 plot stripper, grab samples taken at harvest for turnouts and lint samples for HVI analysis

Center pivot irrigation and rainfall by month in inches:

	May	June	July	Aug	Sept	Oct	Total
Irrigation:	1.25	1.75	2.00	5.00	3.00	--	13.00
Rainfall:	3.18	4.69	5.93	2.22	2.01	2.14	20.17
Total:	4.43	6.44	7.93	7.22	5.01	2.14	33.17

Daily temperatures, rainfall, and other weather data are presented in the Mesonet data for the site (see appendix for Fort Cobb Mesonet site). Note: 5 rainfall events totaling 2.22 inches were recorded at the site in August, but due to instrumentation failure were not recorded by the Mesonet.

Table 1. Yield and agronomic results from the OSU cotton official variety test, Caddo Research Station, Fort Cobb, OK 2013.

Entry	Lint yield	Grab sample turnout		Boll sample lint fraction		Boll size	Seed index	Lint index	Seed per boll	Storm resistance	Final plant height
		Lint	Seed	Picked	Pulled						
	lb/acre	------------------------% ------------------------				g seed cotton/boll	g wt 100 fuzzy seed	g wt lint from 100 fuzzy seed	count/boll	visual scale (1=loose, 9=tight)	inches
PhytoGen PHY 333WRF	2358	26.7	44.8	42.9	33.1	8.1	10.3	8.0	33.5	4	42
Deltapine DP 1321B2RF	2350	28.0	44.9	43.9	34.4	7.3	9.9	7.9	31.8	5	40
Deltapine DP 0912B2RF	2264	26.6	45.8	40.5	32.7	7.8	11.1	7.8	32.6	3	37
Dyna-Gro DG 2285B2RF	2216	26.4	47.5	41.9	33.0	7.5	10.7	7.8	31.5	6	40
NexGen NG 1511B2RF	2195	27.6	43.7	43.9	34.3	7.9	10.5	8.5	31.9	5	39
All-Tex CT13125B2RF	2192	26.6	46.1	43.1	33.9	7.8	10.7	8.2	32.1	5	43
PhytoGen PHY 339WRF	2186	27.3	48.3	42.9	33.9	6.9	9.9	7.6	30.6	5	42
PhytoGen PHY 499WRF	2160	26.7	44.0	44.2	35.6	7.5	10.0	7.9	33.5	5	45
Dyna-Gro DG 2595B2RF	2142	27.2	46.6	45.7	33.7	7.3	10.2	7.9	31.2	5	39
Stoneville ST 4747GLB2	2127	26.3	46.3	41.9	32.6	8.1	10.9	8.2	32.4	7	37
PhytoGen PHY 367WRF	2106	25.6	47.3	42.2	32.6	7.3	10.3	7.6	31.3	5	39
All-Tex AT Nitro-44 B2RF	2092	25.4	48.3	41.1	33.2	7.7	10.8	7.8	32.8	7	38
Deltapine DP 1219B2RF	2091	26.3	46.9	42.9	33.4	6.8	9.0	6.8	33.3	5	46
FiberMax FM 2484B2F	2074	26.7	45.9	42.6	33.6	7.4	10.9	8.3	30.0	7	39
All-Tex AT Epic RF	2059	26.5	45.0	43.5	33.8	7.9	10.7	8.5	31.7	4	43
Croplan Genetics CG 3428B2RF	2056	25.1	45.0	43.7	32.7	7.2	9.5	7.5	31.2	5	41
PhytoGen PHY 375WRF	2052	25.3	45.4	44.4	33.4	8.3	10.7	8.1	34.4	3	42
Stoneville ST 5458B2RF	2048	25.3	47.8	40.2	32.0	7.5	11.3	7.8	30.9	5	42
FiberMax FM 2011GT	2012	25.9	45.0	42.3	33.6	8.8	12.3	9.3	31.8	8	39
Deltapine DP 1044B2RF	1997	24.6	48.5	41.6	32.5	6.4	9.6	7.0	29.8	7	40
Dyna-Gro DGCT 12353B2RF	1989	26.4	45.3	43.9	32.5	7.4	10.4	8.4	28.9	7	45
Stoneville ST 4946GLB2	1986	24.2	45.6	41.3	32.7	8.9	11.8	8.6	34.0	7	40
FiberMax FM 9180B2F	1935	23.8	48.9	39.4	31.4	7.9	11.7	7.7	32.0	8	37
Croplan Genetics CG 3156B2RF	1919	25.4	44.6	42.0	32.6	6.9	10.0	7.5	30.2	6	40
Deltapine DP 1359B2RF	1901	26.1	46.7	42.8	33.3	7.3	8.8	6.7	36.1	4	47
Croplan Genetics CG 3787B2RF	1893	25.4	43.8	44.6	34.3	7.9	9.4	7.7	35.3	4	42
FiberMax FM 9058F	1871	24.6	47.1	40.5	31.5	8.5	11.5	7.9	33.7	8	39
NexGen NG 3348B2RF	1870	24.1	51.1	38.6	30.5	7.7	11.7	7.4	31.8	7	36
FiberMax FM 9250GL	1829	23.8	47.6	40.8	31.7	9.1	12.2	8.6	33.4	8	41
NexGen NG 4010B2RF	1753	22.5	46.0	40.5	31.6	7.5	11.0	7.6	31.2	5	41
NexGen NG 4012B2RF	1749	24.3	46.0	41.4	32.3	7.8	10.6	7.7	33.0	5	43
FiberMax FM 1944GLB2	1744	23.9	47.9	40.2	31.8	7.7	11.7	8.3	29.5	6	35
PhytoGen PHY 725RF	1687	23.7	48.8	39.3	31.3	7.7	11.9	7.8	30.6	3	43
Test average	2027	25.6	46.4	42.1	32.9	7.7	10.7	7.9	32.1	6	41
CV, %	6.7	3.3	3.2	3.5	2.9	7.3	5.5	5.3	7.3	9.7	7.5
OSL	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0961	<0.0001	<0.0001
LSD	190	1.4	2.4	2.4	1.6	0.9	1.0	0.7	3.2†	1	4

CV - coefficient of variation.

OSL - observed significance level, or probability of a greater F value.

LSD - least significant difference at the 0.05 level, † indicates significance at the 0.10 level.

Table 2. Fiber property results from the OSU cotton official variety test, Caddo Research Station, Fort Cobb, OK 2013.

Entry	Micronaire	Length	Staple	Strength	Uniformity	Elongation	Reflectance	Yellowness
	units	inches	32nds inch	g/tex	%	%	rd %	+b %
All-Tex CT13125B2RF	3.6	1.21	38.7	31.1	82.4	9.1	70.1	6.1
All-Tex AT Epic RF	4.3	1.15	36.9	30.9	83.5	9.7	73.4	7.5
All-Tex AT Nitro-44 B2RF	3.6	1.31	42.1	32.9	82.7	8.3	67.1	6.2
Croplan Genetics CG 3156B2RF	3.2	1.18	37.8	30.1	82.3	7.4	68.3	5.8
Croplan Genetics CG 3428B2RF	4.3	1.27	40.6	30.1	83.0	8.4	74.7	6.9
Croplan Genetics CG 3787B2RF	4.1	1.21	38.8	29.7	83.3	8.9	75.6	7.1
Dyna-Gro DG 2285B2RF	4.0	1.22	38.9	31.4	82.7	9.3	69.9	6.6
Dyna-Gro DG 2595B2RF	4.3	1.19	38.1	30.3	81.9	8.3	72.0	6.4
Dyna-Gro DGCT 12353B2RF	4.5	1.17	37.6	31.3	83.2	7.7	75.2	7.3
Deltapine DP 0912B2RF	4.4	1.14	36.4	30.7	82.3	8.9	68.9	6.5
Deltapine DP 1044B2RF	3.8	1.18	37.8	31.9	83.0	9.4	71.2	6.5
Deltapine DP 1219B2RF	3.8	1.21	38.8	32.0	81.0	7.8	72.6	6.7
Deltapine DP 1321B2RF	4.3	1.20	38.4	32.4	83.5	9.7	68.6	6.5
Deltapine DP 1359B2RF	3.7	1.23	39.2	30.7	79.6	8.1	71.5	7.2
FiberMax FM 1944GLB2	3.7	1.24	39.7	32.2	82.6	6.9	72.6	5.8
FiberMax FM 2011GT	3.9	1.22	39.1	31.7	82.5	7.1	69.6	6.4
FiberMax FM 2484B2F	3.5	1.22	39.1	31.0	81.1	7.0	74.1	6.2
FiberMax FM 9058F	3.6	1.25	40.1	31.1	82.5	7.3	70.4	6.3
FiberMax FM 9180B2F	3.8	1.23	39.3	32.1	83.1	7.3	71.9	5.8
FiberMax FM 9250GL	3.9	1.23	39.2	31.3	82.4	6.3	70.6	5.8
NexGen NG 1511B2RF	4.4	1.17	37.4	31.3	82.9	9.4	70.4	6.8
NexGen NG 3348B2RF	3.5	1.19	38.2	30.9	82.1	8.0	67.3	6.1
NexGen NG 4010B2RF	3.8	1.23	39.4	33.9	82.5	8.3	67.5	6.9
NexGen NG 4012B2RF	3.7	1.22	38.9	32.2	82.3	7.4	69.3	6.5
PhytoGen PHY 333WRF	3.6	1.20	38.5	30.5	82.2	7.5	65.6	6.7
PhytoGen PHY 339WRF	3.9	1.21	38.7	31.6	82.2	8.2	71.6	6.2
PhytoGen PHY 367WRF	3.8	1.19	38.0	32.0	81.1	8.6	67.7	6.8
PhytoGen PHY 375WRF	3.7	1.19	38.2	29.1	81.3	8.1	70.1	6.7
PhytoGen PHY 499WRF	4.0	1.20	38.3	33.3	83.0	9.0	66.2	6.6
PhytoGen PHY 725RF	3.9	1.25	40.0	35.1	82.9	8.6	66.6	7.1
Stoneville ST 4747GLB2	4.0	1.24	39.6	29.1	80.6	6.4	68.5	5.3
Stoneville ST 4946GLB2	3.8	1.23	39.3	32.9	83.4	8.8	69.2	6.1
Stoneville ST 5458B2RF	4.2	1.21	38.7	31.2	81.5	7.4	66.9	6.8
Test average	3.9	1.21	38.8	31.5	82.3	8.1	70.2	6.5
CV, %	4.9	2.1	2.1	3.5	1.4	5.7	3.1	4.6
OSL	<0.0001	<0.0001	<0.0001	<0.0001	0.0216	<0.0001	<0.0001	<0.0001
LSD	0.3	0.04	1.3	1.8	1.9	0.8	0.4	0.5

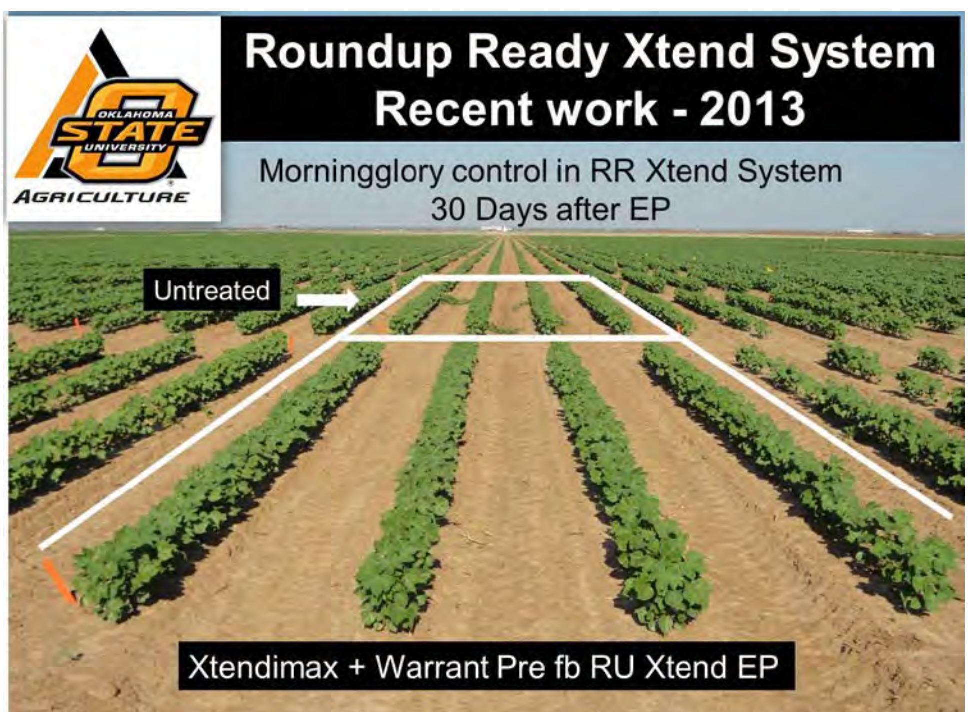
CV - coefficient of variation.
OSL - observed significance level, or probability of a greater F value.
LSD - least significant difference at the 0.05 level.

Weed Control

Results from a recent survey show that Oklahoma cotton producers continue to struggle with tough weeds in their cotton. Despite the fact that weed resistance is growing in most cotton producing regions surrounding Oklahoma, our growers seem committed to limited or no-till production. These production systems depend heavily on effective herbicide programs to remove competitive weeds from their growing environment. When weeds are allowed to exist with the cotton crop, their competitive nature results in lost plant stands, harvest complications and reduced yields. Maintaining a weed free environment with an effective herbicide program eliminates all of these problems. Recent feedback from Oklahoma growers indicates that horseweed and pigweed are the top two "most difficult to control" weeds in their cotton. Our efforts over the last few years have centered around the control of these two weeds. Unfortunately, according to both OSU testing and grower testimonials, these are the two weeds most reported to be resistant to glyphosate herbicide (Roundup). Managing these challenges with the current technology requires several key elements. Currently there are no in-season herbicides available to growers that effectively control horseweed in a growing cotton crop. Although glufosinate (Liberty) does have activity on horseweed and may be used over-the-top of Liberty Link and Glytol-Liberty Link "stacked" cotton varieties, its inconsistency on pigweed (2nd most difficult to control weed for Oklahoma growers) reduces its appeal as a basis for herbicide programs in Oklahoma. Therefore, in order to effectively control horseweed we must target the window prior to the establishment of a cotton crop. Preplant burndown herbicides can effectively control horseweed when used properly and according to OSU recommendations. Weed size at application time is critical. Horseweed is a winter annual that germinates in the fall or winter and remains in the rosette (flat, prostrate) stage until late spring. During late spring it shifts to vertical growth and begins bolting. Once this weed initiates vertical growth it becomes very difficult to control with available herbicides. Effective control can be achieved when targeting the appropriate weed stage. Dicamba and 2,4-D are the basis for effective preplant control of horseweed ahead of cotton production. Our studies have shown that the inclusion of 1.0 lb ai/A of 2,4-D or 0.25 lb ai/A of dicamba results in effective horseweed control when applied at the appropriate time. Pigweed continues to present problems for many growers in Oklahoma. The rapid spread of glyphosate resistant pigweed around the Cotton Belt and increasing frequency of complaints within Oklahoma require that we adopt an effective pigweed control strategy now rather than ponder the question as to whether or not we have glyphosate resistance. Fortunately there are several options available to growers. Residual herbicides and the inclusion of herbicides with different modes of action are key components of an effective strategy. Specific recommendations for season-long programs can be found within this report. In addition several studies were established in 2013 to evaluate new technologies that may be effective considerations for growers in the future. Most of these projects are focused on the two most difficult to control weeds in Oklahoma cotton, horseweed and pigweed. As stated in the opening letter, some of these projects include treatments that are not currently labeled. Always consult local extension resources for current recommendations and always read and follow all current product labeling.

Herbicide Technology on the Horizon

Throughout cotton's history we can note important, game-changing technological advancements in weed control (Treflan, Caparol, Staple, the BXN System, the Roundup Ready System, the Liberty Link System, Roundup Ready Flex, etc.) Monsanto and Dow Agrosciences expect to release new technologies in 2015 and 2016, pending regulatory approvals, that may be of similar magnitude. Monsanto's Roundup Ready Xtend (RRX) Crop System is expected to be available to cotton producers in 2015. This system will allow over-the-top applications of glyphosate, glufosinate and dicamba herbicides for weed control. This will be the first triple-stacked herbicide system to enter the marketplace. Currently Bayer Cropsciences offers a double-stacked Glytol-Liberty Link system (glyphosate and glufosinate herbicides). Two new formulations of dicamba (with lower volatility) will be marketed and labeled specifically for use with this herbicide trait package. In addition to Monsanto's proprietary formulation of dicamba (Xtendimax), BASF will also be marketing their own formulation (Engenia) specifically labeled for RRX cotton. This technology was evaluated in Oklahoma in 2013. Excellent crop tolerance of over-the-top broadcast applications of dicamba was observed. In addition, applications of Xtendimax (stand alone dicamba product) and Roundup Xtend (premix combination of glyphosate and dicamba) were evaluated in combination with residual herbicide programs and excellent in-season weed control was observed.



In addition to this technology Dow Agrosciences is planning to release the Enlist Cropping System for cotton in 2016. This would also be a triple stacked herbicide tolerant system utilizing glyphosate, glufosinate and 2,4-D. Similar to the Monsanto system, this trait will require the use of a new, specific herbicide formulation. Dow Agrosciences has developed a new (choline) formulation of 2,4-D reported to have ultra low volatility as compared to currently marketed products. This technology was also evaluated in 2013. As with the previous system excellent crop tolerance of over-the-top broadcast applications of Enlist Duo (premix of 2,4-D + glyphosate) was observed. Additionally, excellent weed control was observed when a residual program (Prowl H2O) was applied preemergence followed by an early postemergence application of Enlist Duo.

Pigweed Control with Engenia

Herbicide resistant weeds continue to garner most of the attention when it comes to weed control in cotton. Although Oklahoma is not plagued with the level of pigweed problems experienced in other parts of the Cotton Belt (Southeast) we are relatively close to problems experienced over the last few years on the South Plains of Texas. Given that our predominant winds blow from that direction and that equipment is regularly traded across state lines, we fully expect to continue to encounter problems in this area. New technology being developed from Monsanto and Dow AgroSciences should provide grower's with new, effective options for the control of glyphosate resistant pigweed in the near future. Monsanto (pending regulatory approval) is planning to release the Roundup Ready Xtend (RRX) Cotton System in 2015. This system will allow over-the-top broadcast applications of dicamba to cotton varieties with this new trait. In addition, BASF is also scheduled to release (in 2015) a new 5 lb/gallon formulation of dicamba (Engenia) that coincides with the release of the RRX cropping system from Monsanto. This product will also be labeled for over-the-top broadcast applications to RRX cotton. Similar to Monsanto's Xtendimax (3 lb/gallon dicamba), Engenia is reported to be a low volatility formulation delivering the same effective broadleaf weed control to which we are accustomed. This new herbicide technology was evaluated in 2013. The project was conducted on fallow ground (no cotton crop). Six early postemergence treatments were applied on July 11, 2013 to palmer amaranth 2-6 inches in height. Teejet XRC 80015 spray nozzles were used to apply treatments in 10 gallons of water at 38 PSI. Roundup Powermax was applied alone at 22 oz/A. Liberty was applied alone at 29oz/A. Roundup was tank mixed with Liberty at the same rates previously mentioned. Engenia was applied alone at 12.8 oz/A or in combination (at same rate) with either 22 oz/A Roundup Powermax or 29 oz/A Liberty. July 11th was the 7th consecutive day of high temperatures at 100°F or greater. Although the temperature at application (7:15 a.m.) was only 77°F, the high for the day was 106°F with the next two days also reaching 105°F or 106°F. Soil moisture at the time of application was very limited and the pigweeds observed at application time (in the morning) were indicating that they were not completely recovering from the previous day's heat stress. Observations were made at 14 and 30 days after treatment (DAT). Data are presented below in figure 1. Roundup Powermax (RU) applied alone at 22 oz/A controlled palmer amaranth approximately 67% 14 DAT. Similar control was observed from combinations of RU at 22 oz/A + Liberty at 29 oz/A or applications of Engenia alone at 12.8 oz/A 14 DAT. Liberty alone applied at 29 oz/A only provided 22% control of palmer amaranth 14 DAT. Combinations of Engenia at 12.8 oz/A with either RU or Liberty controlled palmer amaranth 90-95% 14 DAT. By 30 DAT the insufficient control observed early on (at 14 DAT) resulted in complete loss of control. A total of 1.7 inches of rainfall was recorded within a week of the application and this led to the recovery of injured palmer amaranth and an additional flush of palmer amaranth in plots that received RU alone, Liberty alone or combinations of RU + Liberty. Essentially no palmer amaranth control was observed from these treatments by 30 DAT. Plots receiving Engenia alone or in combination with RU or Liberty controlled palmer amaranth 83-87% 30 DAT.

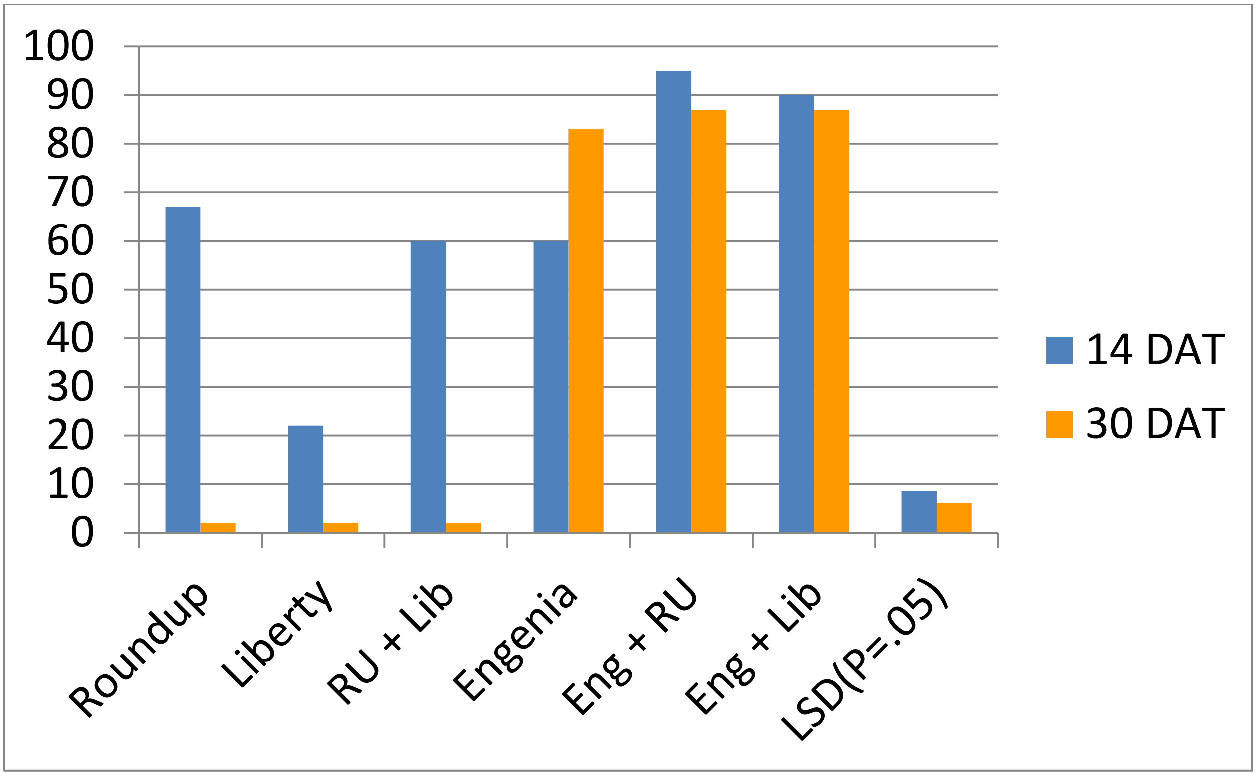


Figure 1. Palmer amaranth control from Engenia herbicide.

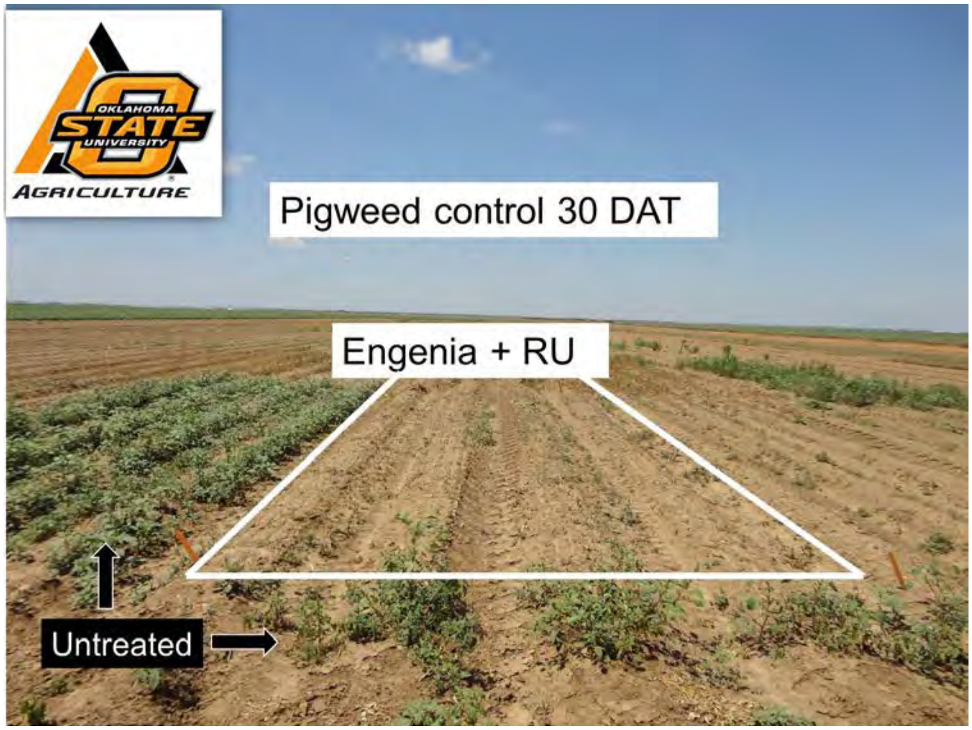


Figure 2. Engenia + Roundup Powermax 30 DAT.

COTTON HERBICIDE SUGGESTIONS

Read and follow all label directions before product use.

Products with Residual Control Highlighted in Yellow

Trade Name, Formulation, and Application Rate	Active Ingredient(s), Similar Products and MOA Group	Application Timing(s), EPP-early preplant, PPI-preplant incorporated, PRE-preemergence, or POST-postemergence	Special Instructions and Remarks
2,4-D LV6 5.6 lb ai per gallon **All applications:** 2/3 – 2 2/3 pt /A For broadleaf weeds only	Active Ingredients: 2,4-Dichlorophenoxyacetic Acid MOA: 4	EARLY PRE-PLANT. **Apply at least 30 days prior to planting cotton for control of existing broadleaf weeds or potential for crop injury exists.** Tank-mix with glyphosate for additional control of grass species.	Coverage is essential for good control. Do not apply this product through any type of irrigation system. In order to maximize control of horseweed, apply before horseweed passes the rosette stage (prior to upright growth). A minimum of 1.0 lb ai/acre is recommended for optimum horseweed control.
Aim 2 EC 2.0 lb ai per gallon **EPP to PRE:** Up to 2.0 oz/A **Hooded and Post (directed)** Up to 1.6 oz/A For broadleaf weeds only	**Active Ingredients:** **Carfentrazone** **Similar Products:** None MOA: 14	**EARLY PRE-PLANT to PRE.** May be applied no later than one day after cotton planting. **Hooded and Post (directed).** Cotton less than 12 inches in height requires closed hood applications in order to avoid any contact with cotton stem or foliage or potential for crop injury exists. For layby applications cotton must be at least 12 inches in height and have sufficient bark on stem to avoid contact with green stem tissue.	Aim provides absolutely no grass control therefore tankmixing with glyphosate is recommended when grasses are present. **Hooded and Post (directed).** Do not apply when winds are above 10 mph or at application speeds above 5 mph. 10 GPA minimum spray volume. Include crop oil concentrate at 1% v/v. **Coverage is essential for good control.** When attempting to control volunteer cotton apply before volunteer reaches 5 leaf stage.
Assure II 0.88 lb ai per gallon **POST applications:** 5-12 fl oz. /A For grass weeds only	**Active Ingredients:** Quizalofop **Similar Products:** None **MOA:** 1	**POST.** Apply to young, actively growing grasses according to the rate chart listed on the label. If field is to be irrigated, apply product after irrigation. **Do not** apply more than 18 fl oz /A per season.	**Do not** apply this product through any type of irrigation system. **Do not** apply within 80 days of harvest. **Do not** feed forage or hay from treated areas.
Caparol 4 lb ai per gallon **PRE applications:** 2.4 pt /A For broadleaf and some grass weeds	**Active Ingredients:** Prometryn **Similar Products:** None **MOA:** 5	**PRE.** Apply at planting or shortly after planting (prior to cotton emergence) at the rate of 2.4 to 4.8 pt/A depending on soil type. See label for soil type and rate restrictions. **POST (layby).** Prevent spray from contacting green foliage or injury may occur. Use precision application equipment so the spray is accurately directed to the base of the cotton plants and still thoroughly covers soil and weeds beneath the cotton plants.	**Do not** feed treated forage to livestock, or graze treated areas, or illegal residues may result. **Do not** use on glandless cotton varieties, or crop injury will occur. **Do not** make more than one application per year. **POST-layby**. Cotton must be at least 12 inches tall. Rates vary from 1.6-3.2 pt/A depending on soil classification. See label for rate information according to soil type. Apply before weeds are two inches tall. May be tank-mixed with 2 lb ai/A MSMA at layby for morningglory control. When applying to emerged weeds, add 2 qt of surfactant per 100 gal of spray mixture.
Clarity 4 lb. ai per gallon **EPP applications:** 8 fl oz /A For broadleaf weeds only	**Active Ingredients:** Dicamba **Similar Products:** Banvel Rates may vary due to formulation. **MOA:** 4	**EARLY PREPLANT.** For best performance, apply when weeds are in the 2-4 leaf stage and rosettes are less than 2" in diameter. Following application and a minimum 1" of rainfall or overhead irrigation, a waiting interval of 21 days is required per 8 fluid ounces per acre or less. These intervals must be observed prior to planting cotton or potential for crop injury exists.	**Do not** apply through any type of irrigation equipment. **Do not** cultivate within 7 days after application. **For optimum control of horseweed apply a minimum of 8 oz/A to 2-4 leaf weeds or rosettes less than 2 inches across.** Consult label for cotton plant-back interval following application. Tank-mix with glyphosate for additional control of grass species.

COTTON HERBICIDE SUGGESTIONS (CONT'D)

Read and follow all label directions before product use.

Trade Name, Formulation, and Application Rate	Active Ingredient(s), Similar Products and MOA Group	Application Timing(s), EPP-early preplant, PPI-preplant incorporated PRE-preemergence, or POST-postemergence	Special Instructions and Remarks
Dual II Magnum 7.64 lb ai per gallon **All applications:** 1 to 1.33 pt /A For small-seeded broadleaf and annual grass weeds	**Active Ingredients:** Metolachlor **Similar Products:** Dual Magnum Cinch **MOA:** 15	**PPI.** Apply and incorporate into top 1 inch immediately before planting, at planting, or after planting, but before crop or weeds emerge. **PRE.** Apply to soil surface at planting or after planting, but before weeds or crop emerges. **POST.** Apply after cotton emergence but prior to weed emergence. Will not control weeds that have already emerged prior to application. **All applications.** Apply at a rate of 1.0 pt/A on sandy loams, 1.0-1.33 pt/A on medium soil, or 1.33 pt/A on fine soils.	**Do not** use on sands and loamy sand. **Do not** feed forage from treated areas to livestock. **PPI.** PPI application is recommended if furrow irrigation is used or when a period of dry weather after application is expected. Crop should be planted below the level of incorporation; i.e., at least 1 inch on fine soils and 1.5 inches on coarse and medium soils. **PRE. Do not** apply to areas where water is likely to pond over the bed. **Do not** make broadcast applications to crops planted in furrows more than 2 inches deep.
Fusilade DX 2 lb ai per gallon **POST applications:** 48 fl oz /A For grass weeds only	**Active Ingredients:** Fluazifop **Similar Products:** None **MOA:** 1	**POST.** Refer to label for weed specific application rates and timing. Thorough coverage of all grass foliage is important for good activity. Optimum control is achieved when young actively growing grasses are treated that are not under stress from moisture, temperature, low soil fertility, mechanical, or chemical stress. **Always** add either crop oil concentrate, nonionic surfactant, or other adjuvant.	**Do not** apply to crop after boll set. **Do not** harvest within 90 days of application. **Do not** graze fields or harvest for forage or hay. **If applied through irrigation system,** apply only through sprinkler systems including center pivot, lateral move, end tow, side (wheel) roller, big gun, solid set, or hand move. **Do not** apply through any other type of irrigation system.
Fusion 2.56 lb ai per gallon **POST applications:** 6-12 fl oz /A For grass weeds only	**Active Ingredients:** Fluazifop Fenoxaprop **Similar Products:** None **MOA:** 1 & 1	**POST.** Best control of susceptible grasses is obtained when applied to actively growing grasses before they exceed the recommended growth stages listed, refer to label for list of grasses and application rates for specific weeds and areas.	**Do not** apply this product through any type of irrigation system. **Do not** apply if rainfall is expected within 1 hour. **Do not** apply more than 24 fluid ounces per acre per season. **Do not** apply after boll set. **Do not** harvest within 90 days of application. **Do not** graze fields or feed treated forage or hay to livestock.
Roundup Power Max 5.5 lb ai per gallon **All applications:** 22 to 32 oz /A Non-selective control of broadleaf and grass weeds	**Active Ingredients:** Glyphosate **Similar Products:** Many Rates may vary due to formulation. **MOA:** 9	**EARLY PREPLANT to PRE.** May be applied before, during or after planting crop. **POST (conventional cotton).** May be applied through hooded sprayers, recirculating sprayers, shielded applicators or wiper applicators. Allow at least 7 days between application and harvest. **POST over-the-top (Roundup Ready Flex or GlyTol cotton varieties).** Apply anytime from preemergence to 7 days prior to harvest. Late season applications may require directed applications to ensure proper weed coverage.	**Do not** apply through any type of irrigation system. **Do not** apply more than 5.3 qt per acre per year. **Refer** to label for application rates for specific weed types. **Do not** apply postemergence to any crops other than those listed as Roundup Ready Flex or GlyTol. **Do not** apply to Roundup Ready Flex or GlyTol crops within 7 days of harvest. For horseweed control apply a tank-mix of 22 oz/A Roundup PowerMax + a minimum of 1.0 lb ai /A 2,4-D or 0.25 lb ai/A of Dicamba. **In order to maximize control, apply before horseweed passes the rosette stage .**

COTTON HERBICIDE SUGGESTIONS (CONT'D)

Read and follow all label directions before product use.

Trade Name, Formulation, and Application Rate	Active Ingredient(s), Similar Products and MOA Group	Application Timing(s), EPP-early preplant, PPI-preplant incorporated PRE-preemergence, or POST-postemergence	Special Instructions and Remarks
Gramoxone Inteon[r] 2 lb ai per gallon **EPP to PRE applications:** 2.5 to 4 pt /A Non-selective control of broadleaf and grass weeds	**Active Ingredients:** Paraquat **Similar Products:** Firestorm (3 lb) **MOA:** 22	**EARLY PREPLANT to PRE.** Apply prior to, during, or after planting, but before crop emergence. For fallow bed treatment, beds should be preformed to permit maximum broadleaf weed and grass emergence prior to treatment. Seeding should be done with minimum soil disturbance.	**Do not** apply this product through any type of irrigation system. **Always** add nonionic surfactant. Complete coverage is essential for good control.
Liberty 280 (formerly Ignite) 2.34 lb ai per gallon **POST applications:** 22 to 29 fl oz /A Non-selective control of broadleaf and grass weeds	**Active Ingredients:** Glufosinate-ammonium **Similar Products:** None **MOA:** 10	**EARLY PREPLANT to PRE.** Apply to actively growing weeds up to 120 prior to planting cotton. **POST over-the-top. Apply POST, over LibertyLink Cotton varieties only,** to actively growing weeds when the cotton has emerged and up to the cotton early bloom stage.	**Do not** apply more than 43 fl oz/A in a single application. **Do not** apply more than 87 fl oz/A in a growing season if 22-29 oz/A rates are used. **Do not** apply more than 72 oz/A in a growing season if first application of up to 30-43 oz/A is used. **Do not** apply within 70 days prior to harvest. Herbicide should be applied broadcast in a minimum of 15 gallons of water per acre. Use a spray volume of 20 to 40 gallons per acre for dense weed/crop canopies so that thorough spray coverage will be obtained.
Karmex DF 80% DF **EPP applications:** See table **PRE applications:** See table **POST applications:** 1 to 1.5 lb /A For small seeded broadleaf and annual grass weeds	**Active Ingredients:** Diuron **Similar Products:** Direx 4L Direx 80 DF Diuron 4L Diuron 80 DF **MOA:** 7	**EARLY PREPLANT.** Apply from 15 to 45 days prior to planting. If weeds are present the addition of a non-ionic surfactant is recommended. Weeds should be 2 inches or smaller. **PRE. Do not** apply to sand or loamy sand soils. Use only where crop is planted on flat or raised seedbeds (not planted in a furrow). Apply 1-2 lb/A according to labeled guidelines regarding soil texture. **POST-directed applications.** Apply 1 to 1.5 lb/A when crop is at least 12" high. In irrigated crops, best control is obtained if the field is irrigated within 3-4 days after application. Apply to soil beneath crop and between rows immediately after last cultivation.	**Do not** spray over the top of crop plants. **Do not** apply to sand or loamy sand soils. **Do not** use on soils with less than 1% organic matter as crop injury may result. **Do not** use in preplant or preemergence applications where soil-applied organophosphate insecticides are used due to potential for severe crop injury and possible stand loss. **Do not** allow livestock to graze treated cotton. **EPP & PRE.** If less than the maximum rate is used, a second PRE application can be made, but total can not exceed maximum use rates listed on label. **Do not** apply PRE if maximum application rate was used in preplant application.

Karmex DF Application Rates		
Soil Texture	**Rate/Acre**	**Rate/Acre/Season**
Sandy loam, Loam, Silt loam, Silt	1 lb /A	1 lb /A
Sandy clay loam, Clay loam, Silty clay loam, Sandy clay	1.25 lb /A	1.25 lb /A
Silty clay, Clay	2 lb /A	2.75 lb /A

COTTON HERBICIDE SUGGESTIONS (CONT'D)

Read and follow all label directions before product use.

Trade Name, Formulation, and Application Rate	Active Ingredient(s), Similar Products and MOA Group	Application Timing(s), EPP-early preplant, PPI-preplant incorporated PRE-preemergence, or POST-postemergence	Special Instructions and Remarks
MSMA 6.6 6.6 lb ai per gallon **All applications:** 0.5 to 2.5 pt /A For broadleaf and grass weeds	**Active Ingredients:** MSMA **Similar Products:** MSMA 6 Plus 120 Herbicide 912 Herbicide **MOA:** 17	**EARLY PREPLANT.** Apply preplant or postplant up to cracking of soil before cotton emergence using ground or aircraft equipment. Apply at a rate of 2.5 pt/A of product with a suitable surfactant. **POST (over-the-top).** Apply over the top when crop is 3 to 6 inches tall or up to early first square stage, apply at a rate of 1 to 1.25 pt/A with a suitable surfactant. **Will cause significant leaf burn of the crop.** **POST (Directed Spray).** Applicable as a directed spray with ground equipment when crop is 3 inches tall to first bloom, apply at a rate of 2.5 pt/A with a suitable surfactant.	**Apply** over the top of crop only as a salvage operation; apply only to healthy, rapidly growing crops, 3 inches high but no later than 6 inches high. **POST (Directed Spray). Do not** apply as a directed spray after the first bloom. A second or repeat application, if needed, should be timed about 1 to 3 weeks after first application.
Poast Plus 1 lb ai per gallon **POST applications:** 1.5 to 3.75 pt /A For grass weeds only	**Active Ingredients:** Sethoxydim **Similar Products:** Poast **Rates may vary due to formulation.** **MOA:** 1	**POST.** Applications can be made to actively growing weeds as aerial, broadcast, band, or spot spray applications. Most effective control is achieved if applied when weeds are small and actively growing.	**Do not** apply this product through any type of irrigation system. **Do not** apply within 40 days of harvest. To achieve consistent weed control, always use either seed oil or crop oil concentrate. **Do not** cultivate within 5 days before or 7 days after application. **Processed** meal may be fed to animals.

COTTON HERBICIDE SUGGESTIONS (CONT'D)

Read and follow all label directions before product use.

Trade Name, Formulation, and Application Rate	Active Ingredient(s), Similar Products and MOA Group	Application Timing(s), EPP-early preplant, PPI-preplant incorporated PRE-preemergence, or POST-postemergence	Special Instructions and Remarks
Prowl 3.3 EC 3.3 lb ai per gallon **All applications:** See table. For small seeded broadleaf and grass weeds	**Active Ingredients:** Pendimethalin **Similar Products:** Pendimax 3.3 Prowl H2O **MOA:** 3	**EARLY PREPLANT.** Apply up to 15 days prior to planting. **PPI.** Apply up to 60 days prior to planting and incorporate within 7 days of application; however, immediate incorporation is best. **PRE.** Apply overlay application at planting or up to 2 days after planting. Total amount applied per acre cannot exceed the highest labeled rate for a given soil type. **POST/LAYBY.** Apply directly to the soil between rows as a directed spray following the last normal cultivation (layby). **Fall Application.** May be applied for weed control in cotton in the fall, after Oct. 15 (up to 140 days prior to planting). Apply at a broadcast rate of 1.8 pt /A on coarse soils, 2.4 pt /A on medium soils and 3.6 pt /A on fine soils.	**If applied through irrigation system,** use only center pivot, lateral move, end tow, side (wheel) roll, traveler, big gun, solid set, or hand move irrigation systems. **Do not** apply this product through any other type of irrigation system for layby applications. **Do not** apply as a broadcast spray over-the-top of crop. **Do not** feed forage or graze livestock in treated fields. **Product** is most effective when adequate rainfall or overhead irrigation is received within 7 days after application. **Use** higher rates listed for no-tillage applications for control of rhizome johnsongrass in specified soil textures. This use is not recommended for soils with more than 3% organic matter. **There** must be an interval of at least 60 days between the last application and harvest.
Prowl H2O 3.8 lb ai per gallon **All applications:** See table. For small-seeded broadleaf and grass weeds	**Active Ingredients:** Pendimethalin **Similar Products:** Pendimax 3.3 Prowl 3.3 EC MOA: **3**	**EARLY PREPLANT.** Apply up to 15 days prior to planting. **PPI.** Apply up to 60 days prior to planting and incorporate within 7 days of application; however, immediate incorporation is best. **PRE.** Apply overlay application at planting or up to 2 days after planting. Total amount applied per acre cannot exceed the highest labeled rate for a given soil type. **POST/LAYBY.** Apply directly to the soil between rows as a directed spray following the last normal cultivation (layby). **Fall Application.** May be applied for weed control in cotton in the fall, after Oct. 15 (up to 140 days prior to planting). Apply at a broadcast rate of 1.8 pt /A on coarse soils, 2.4 pt /A on medium soils and 3.6 pt /A on fine soils.	**If applied through irrigation system,** use only center pivot, lateral move, end tow, side (wheel) roll, traveler, big gun, solid set, or hand move irrigation systems. **Do not** apply this product through any other type of irrigation system for layby applications. **Do not** apply as a broadcast spray over the top of crop. **Do not** feed forage or graze livestock in treated fields. **Product** is most effective when adequate rainfall or overhead irrigation is received within 7 days after application. **Use** higher rates listed for no-tillage applications for control of rhizome johnsongrass in specified soil textures. This use is not recommended for soils with more than 3% organic matter. **There** must be an interval of at least 60 days between the last application and harvest. **Postemergence** over-the-top broadcast tank-mix applications with Roundup PowerMax may be made **to Roundup Ready Flex** or **GlyTol** cotton varieties between the 4 leaf and 8 leaf growth stages. Over-the-top applications past the 8 leaf stage may result in crop injury and or yield loss. Do not apply over-the-top of cotton with fluid fertilizer or to cotton under stress. Dry ammonium sulfate (at 17 lb/100 gal) or the liquid equivalent must be used when tank-mixing with Roundup PowerMax.

COTTON HERBICIDE SUGGESTIONS (CONT'D)

Read and follow all label directions before product use.

EPP, PPI &/or PRE	Prowl 3.3 EC Broadcast Rates pt/A		
	Soil Texture	**Conventional or Minimum Tillage**	**No-Tillage**
	Coarse	1.2 to 2.4 pt /A	1.8 to 2.4 pt /A
	Medium	1.8 to 2.4 pt /A	2.4 to 3.6 pt /A
	Fine	2.4 to 3.6 pt /A	3.6 to 4.8 pt /A
	For heavy clay soils, apply at a broadcast rate of 3.6 pt /A.		
	Total amount applied per acre cannot exceed the highest labeled rate for a given soil type.		

POST/LAYBY	Prowl 3.3 EC Layby Application Use Rates	
	Soil Texture	**Use Rate pt /A**
	Coarse	1.2 to 1.8 pt /A
	Medium	1.8 to 2.4 pt /A
	Fine	2.4 to 3.6 pt /A

EPP, PPI &/or PRE & Layby	Prowl H2O 3.8 Broadcast Use Rates		
	Soil Texture	**Conventional or Minimum Tillage**	**No-Tillage**
	Coarse	1 to 2 pt /A	2 pt /A
	Medium	2 pt /A	3 pt /A
	Fine	3 pt /A	4 pt /A
	For heavy clay soils, apply at a broadcast rate of 3 pt /A.		
	Total amount applied per acre cannot exceed the highest labeled rate for a given soil type.		

POST alone or tank-mixed with Roundup PowerMax	Prowl H2O 3.8 Broadcast Use Rates Conventional, Minimum or No-till	
	Soil Texture	**Use Rate pt /A**
	Coarse	1 to 2 pt /A
	Medium	1.5 to 2 pt /A
	Fine	2 pt /A

COTTON HERBICIDE SUGGESTIONS (CONT'D)

Read and follow all label directions before product use.

Trade Name, Formulation, and Application Rate	Active Ingredient(s), Similar Products and MOA Group	Application Timing(s), EPP-early preplant, PPI-preplant incorporated PRE-preemergence, or POST-postemergence	Special Instructions and Remarks
Select 2 EC 2 lb ai per gallon **POST applications:** 6 to 16 fl oz /A For grass weeds only	**Active Ingredients:** Clethodim **Similar Products:** Prism **MOA:** 1	**POST.** Apply to actively growing grasses, refer to label for specific rates for weed type. In arid regions, application should be made as soon as possible after irrigation (within 7 days). A second application will generally provide more effective perennial grass control in arid conditions than a single application. Make second application to actively growing grass 2 to 3 weeks after emergence of new growth.	**Do not** apply within 60 days of harvest. **Do not** graze treated fields or feed treated forage or hay to livestock. **Do not** apply through any type of irrigation system. **Do not** apply if rainfall is expected within one hour of application. **Always** use a crop oil concentrate at 1.0 qt /A by ground or 1% v/v in the finished spray volume by air. **Refer** to label for application rates for specific grass species controlled.
Sequence 5.25 lb ai per gallon **All applications:** 2.5 to 4 pt/A Non-selective control of broadleaf and grass weeds	**Active Ingredients:** Metolachlor & Glyphosate **Similar Products:** None **MOA:** 15 & 9	**EARLY PREPLANT.** Apply prior to planting for control of emerged actively growing weeds and soil residual activity. **Do not** incorporate if applied EPP or crop injury will result. **PRE.** Apply after planting in no-till production system for control of emerged actively growing weeds and soil residual activity. **POST on Roundup Ready Flex and GlyTol cotton varieties.** Apply after crop and weeds have emerged for control of emerged actively growing weeds and soil residual activity.	**Do not** apply POST to non-Roundup Ready Flex or non-GlyTol cotton varieties. **Do not** graze or feed forage or fodder from Sequence treated cotton to livestock. **Do not** apply EPP or PRE on sand or loamy sand soils. **POST applications on Roundup Ready Flex or GlyTol cotton varieties:** Make postemergence applications from cotyledon stage to the 10-leaf stage (not to exceed 12 inches tall) of cotton development. **Do not** apply later as severe injury, including yield loss, could occur**. Do not** exceed 2.5 pt of Sequence per acre in a single application on cotton with less than 5 leaves. Apply up to 2.75 pt of Sequence per acre in a single application from the 5-leaf through the 10-leaf stage of cotton. **Do not** use if cotton plants are under stress.
Sharpen 2.85 lb ai per gallon **Early Preplant applications:** 1.0 oz/A For broadleaf weeds only	**Active Ingredients:** Saflufenacil **Similar Products:** None MOA: **14**	**EARLY PREPLANT.** Apply at least 42 days prior to planting cotton for control of emerged actively growing weeds and soil residual activity or crop injury may occur.	**Do not** plant cotton until 42 days and an accumulation of 1 inch of rainfall has occurred after application in order to avoid crop injury. **Do not** apply to coarse soils classified as sand with less than 1.5% organic matter or cotton injury may occur. **Do not** apply Sharpen with other Group 14/GroupE herbicides (such as flumioxazin) as a tank-mix or sequential application within 30 days or crop injury may result. **Do not** apply sharpen where an at-planting application of an organophosphate or carbamate insecticide(s) is planned because severe injury may result. May be tank-mixed with 0.25 lb ai/A Dicamba or 1.0 lb ai/A 2,4-D for horseweed control. **In order to maximize control, apply before horseweed passes the rosette stage (prior to upright growth).** For control of grass species tank-mix with glyphosate. Include either a crop oil concentrate or methylated seed oil at 1% v/v plus ammonium sulfate at 8.5 to 17 lb/100 gal.
Staple LX 3.2 lb ai per gallon **PRE applications:** 1.3 to 2.1 oz /A **POST applications:** 2.6 to 3.8 oz /A For broadleaf weeds only	**Active Ingredients:** Pyrithiobac **Similar Products:** None **MOA:** 2	**PRE.** May be applied preemergence to aid in the control of many problematic weeds. Applications require rainfall or sprinkler irrigation to activate the herbicide. Use the higher application rate for difficult to control weeds or in fields where high infestation of weeds occur. **POST.** Application should be made over-the-top or as a post-directed spray to cotton (begin at cotyledon stage) and actively growing weeds.	**PRE. Do not** apply through any type of irrigation system. **Do not** use on coarse soils such as sands or loamy sands. **Do not** use on soils with less than 0.5% organic matter. **Do not** use on crops planted in furrows. **POST.** Use a minimum of 10 gallons of water per acre by ground or 3 gallons of water per acre by air. All rates are broadcast. Use proportionately less for banded applications. **All applications. Do not** apply more than 5.1 oz/A per year. Add a non-ionic surfactant at the rate of 0.25-0.5% v/v or a crop oil concentrate at the rate of 1-2% v/v with all postemergence applications. Under arid conditions, a crop oil concentrate is recommended. Weed size at application is critical for optimal control, consult label for appropriate weed sizes.

COTTON HERBICIDE SUGGESTIONS (CONT'D)

Read and follow all label directions before product use.

Trade Name, Formulation, and Application Rate	Active Ingredient(s), Similar Products and MOA Group	Application Timing(s), EPP-early preplant, PPI-preplant incorporated PRE-preemergence, or POST-postemergence	Special Instructions and Remarks
Treflan HFP 4.0 lb ai per gallon **PPI applications:** See table. For small seeded broadleaf and grass weeds	**Active Ingredients:** Trifluralin **Similar Products:** Treflan TR-10 Trifluralin HF Trust 10G Trust 4EC Trust Herbicide **MOA:** 3	**Fall applications.** Apply to flat ground and incorporate once within 24 hours. **Spring applications.** Application and incorporation may occur before planting or after planting prior to crop emergence. Use the lower application rates when sequential applications are anticipated. **Layby applications.** Application may be made in established crops from the 4 true leaf stage of growth up to layby, but no less than 90 days before harvest.	**If applying through irrigation system:** Apply only through continuously moving center pivot, lateral move, end tow, solid set, or hand move irrigation systems. **Refer** to label for additional chemigation instructions. **Do not** apply to soils that are wet or are subject to prolonged periods of flooding as poor weed control may result.

Treflan HFP Application Rates

Soil Texture	Spring Application	Fall Application	Chemigation Application	Conservation Tillage	Layby Application
Coarse	1 pt /A	2 pt /A	1-3 pt /A	1-2 pt /A	1 pt /A
Medium	1.25-1.5 pt /A	2 pt /A	1.5-4 pt /A	1.5-2 pt /A	1.5 pt /A
Fine	1.5-2 pt /A	2.5 pt /A	2-4 pt/A	2-4 pt /A	2 pt /A

COTTON HERBICIDE SUGGESTIONS (CONT'D)

Read and follow all label directions before product use.

Valor SX 51% WP **Preplant Burndown applications:** 1 to 2 oz/A **POST-Directed/Hooded applications:** 2.0 oz/A For broadleaf and some grass weeds	**Active Ingredient:** Flumioxazin **Similar Products:** Valor **Rates may vary due to formulation** **MOA:** 14	**EARLY PREPLANT.** A minimum of 14 to 30 days must pass prior to planting cotton after application depending on tillage system and rate applied, consult label. **POST-Directed/Hooded Applications.** Precautions should be taken to avoid contacting the green foliage of cotton plants or severe crop injury may result. Cotton should be at least 6 inches in height at the time of application. Direct the spray onto the bottom 2 inches of the cotton stem-bark layer. **Do not** allow spray to contact green cotton stems. **Layby Application** Layby application of VALOR SX tank-mixes may be made once cotton has developed a minimum of 4 inches of bark and has reached a minimum of 18 inches in height. **Cotton that is smaller than 18 inches in height and/or has less than 4 inches of bark may be injured by VALOR SX applications.** VALOR SX application must be directed to the lower 2 inches of bark to avoid crop injury. Severe crop injury may result if application is made to green or unbarked stem.	**Do not** graze treated fields or feed treated forage or hay to livestock. **Do not** incorporate into the soil after application. **Do not** apply more than 2 oz/A in a single application or 4 oz/A during a single growing season. **Do not** make a sequential Valor WP application within 30 days of the previous Valor application. Do not apply within 60 days of harvest. **Do not** use on crops grown for seed. Only apply with nonionic surfactant, d**o not** apply with crop oil concentrate, methylated seed oil or other types of adjuvants as crop injury may result. Valor should be tank-mixed with glyphosate or MSMA to provide grass control. Consult label for rotation intervals to other crops. Spray equipment used to apply VALOR SX should not be used to apply other materials to any crop foliage
Warrant 3.0 lb ai/gallon **POST applications** 1.25 to 2 qt/A For small-seeded broadleaf and grass weeds	**Active Ingredient:** Acetochlor **Similar Products:** None **MOA:** 15	**POST.** Apply this product postemergence to cotton and preemergence to weeds at 1.25 to 2 qt/A according to soil classification rate chart listed on label. Application should be made after cotton is completely emerged but before bloom.	**Postemergence to Roundup Ready Flex or GlyTol cotton varieties.** This product may be tank-mixed with Roundup agricultural herbicides on Roundup Ready Flex or GlyTol cotton varieties when cotton is completely emerged until cotton reaches first bloom. The optimum timing of application is when cotton is in 2-3 leaf stage. Product may be applied again when cotton is in the 5 to 6 leaf stage if directed to the soil. **Do not make postemergence surface applications using sprayable fluid fertilizer as the carrier because severe crop injury may occur.**

Warrant Application Rates (Broadcast per acre)		
Soil Texture	**Less than 1.5% Organic Matter (quarts)**	**1.5% or More Organic Matter (quarts)**
Coarse	1.25 to 1.6	1.25 to 1.7
Medium	1.25 to 1.7	1.25 to 1.9
Fine	1.25 to 1.9	1.25 to 2.0

Herbicide Program Suggestions
For Fighting/Preventing Glyphosate Resistant Pigweed
In Oklahoma Cotton

Weed Control Programs in Glyphosate Tolerant Cotton Varieties (Roundup Ready Flex, GlyTol)

	Production System	Preplant Burndown or Incorporated	At-plant Burndown or Preemerge	Early to Mid-season Postemergence	Late-season Layby-Hoods
1	Minimum or No-till	Dicamba or 2,4-D + Glyphosate	Glyphosate + Prowl H20	Glyphosate + Staple LX	Aim + Direx
2	Minimum or No-till	Dicamba or 2,4-D + Valor + Glyphosate	Gramoxone SL + Direx	Glyphosate + Warrant	Glyphosate + Direx
3	Minimum or No-till	Dicamba or 2,4-D + Sharpen + Glyphosate	Glyphosate + Dual II Magnum	Glyphosate + Prowl H20	Caparol + MSMA
1	Conventional tillage	Treflan or Prowl H20	Caparol	Glyphosate + Staple LX	Valor + MSMA
2	Conventional tillage	Treflan or Prowl H20	Direx	Glyphosate + Warrant	Aim + Caparol
3	Conventional tillage	Treflan or Prowl H20	Staple LX	Glyphosate + Prowl H20	Direx + MSMA

Without the use of residuals Palmer amaranth can emerge all season long…plan ahead!

Preventing/Fighting Glyphosate Resistance in Oklahoma Cotton

- ✓ ***Plan ahead…devise an effective strategy early.***
  - -Consider season long approach…PPI thru layby
  - -Develop a spray schedule and consider alternatives
  - -Purchase chemical ahead of time if possible

- ✓ ***Return to the residuals…still several options which have different MOA.****
  - -Treflan/Prowl, Aim/Valor, Gramoxone Max, Caparol/Direx, Dual Magnum/Warrant, StapleLX/Pyrimax
  - -Consider potential crop rotational issues when using residuals

- ✓ ***Tank-mixing with glyphosate should be a standard consideration***
  - -Several in-season options, Prowl, Dual, Warrant, Staple, etc.

- ✓ ***Scout thoroughly ….before and after applications.***
  - -Weed size at application time is key, check labels
  - -Identifying failures as early as possible can be critical

- ✓ ***Make every application count!***
  - -Choose appropriate rate for weed size at app….read labels
  - -Properly condition water…8-17 lbs/100 gal AMSO4 prior to the addition of glyphosate to the tank
  - -Use a spray volume that will provide good coverage…dense canopies require more water to effectively reach all weeds
  - -Speed is your enemy…what good is finishing in an hour if it has to be re-sprayed
  - -Avoid speeds that generate excess dust
  - -Avoid spraying in extreme temperatures

- ✓ ***Diversify your practices.***
  - -Don't rule out tillage
  - -Rotation may be necessary

Without the use of a residual product Palmer Amaranth can emerge all season…don't save yourself into a disaster!

***It is recommended that at least two different modes of action (MOA) be used in-season in addition to glyphosate.**

Herbicide How-to:

Understanding Herbicide Mode of Action

Joe Armstrong
Extension Weeds Specialist

The large number of herbicide options—new products, old products with new names, new formulations of old products, premixes, and generics—can make weed control a difficult and confusing task. In addition to knowing the crops in which a herbicide can be used, the weeds it will control, the appropriate rate, and any necessary adjuvants to include, it is also important to know and understand the herbicide's mode of action to design a successful weed management program.

What is "Mode of Action?"

The mode of action is the way in which the herbicide controls susceptible plants. It usually describes the biological process or enzyme in the plant that the herbicide interrupts, affecting normal plant growth and development. In other cases, the mode of action may be a general description of the injury symptoms seen on susceptible plants. In Oklahoma crop production, 11 different herbicide modes of action are commonly used, and each is unique in the way it controls susceptible plants. Some herbicide modes of action comprise several chemical families that vary slightly in their chemical composition, but control susceptible plants in the same way and cause similar injury symptoms.

Herbicides can also be classified by their "site of action," or the specific biochemical site that is affected by the herbicide. The site of action is a more precise description of the herbicide's activity; however, the terms "site of action" and "mode of action" are often used interchangeably to describe different groups of herbicides.

Why is it Important to Know the Mode of Action?

Knowing and understanding each herbicide's mode of action is an important step in selecting the proper herbicide for each crop, diagnosing herbicide injury, and designing a successful weed management program for your production system. Over-reliance on a single herbicide active ingredient or mode of action places heavy selection pressure on a weed population and may eventually select for resistant individuals. Over time, the resistant individuals will multiply and become the dominant weeds in the field, resulting in herbicides that are no longer effective for weed control. Simply rotating herbicide active ingredients is not enough to prevent the development of herbicide-resistant weeds. Rotating herbicide modes of action, along with other weed control methods, is necessary to prevent or delay herbicide-resistant weeds. Always read each product's label to determine the mode of action and best management practices for herbicide-resistant weeds.

Many weeds have developed "cross resistance" and are resistant to multiple herbicides within a single mode of action. Most waterhemp populations in Oklahoma, for example, are cross-resistant to both Scepter (chemical family: imidazolinone) and Classic (chemical family: sulfonylurea). Both of these herbicides are ALS inhibitors, but belong to different chemical families within the same mode of action. Therefore, it is important to not only rotate herbicide active ingredients but also to rotate modes of action to prevent herbicide-resistance weed populations from developing. One of the most effective ways to rotate herbicide modes of action is through crop rotation.

Weeds that have developed "multiple resistance" are resistant to herbicides from two or more modes of action. At this time, there are no weeds in Oklahoma that have been confirmed as resistant to multiple herbicide modes of action; however, instances of weeds with multiple resistance can be found in neighboring states. ALS-resistant, PPO-resistant, and glyphosate-resistant populations of waterhemp have been confirmed in Kansas. As well, Italian ryegrass populations in Arkansas have been confirmed to be resistant to both ALS- and ACCase inhibitor herbicides.

How can I Determine the Herbicide's Mode of Action?

Information regarding each product's mode of action can sometimes be found on the front of the herbicide label. Often, the herbicide is described as being a member of a particular numbered group. These numbers refer to a specific mode of action and were developed to consistently organize herbicides based on their mode of action. For example, "Group 1" herbicides are ACCase inhibitors and "Group 2" herbicides are ALS inhibitors. Some herbicides will list the mode of action somewhere in the general instructions or product description in the label. In other situations, products may not mention the mode of action anywhere in the label. If you are unsure of the herbicide's mode of action, contact your local county extension educator for clarification.

What are the Different Modes of Action? What are their Characteristics?

The following is a short description of the 11 most commonly used herbicide modes of action in Oklahoma crop

(Continued on page 4)

ACCase Inhibitors

Group	*Chemical family*	*Trade names*	*Active ingredient*
1	Arloxyphenoxypropionate “FOPs”	Assure II	quizalofop
		Hoelon[r]	diclofop
		Fusilade	fluazifop
		Puma	fenoxaprop
1	Cyclohexanedione “DIMs”	Select, Select Max, others	clethodim
		Poast, Poast Plus	sethoxydim
1	Phenylpyrazoline “DENs”	Axial XL	pinoxaden

ALS Inhibitors

Group	*Chemical family*	*Trade names*	*Active ingredient*
2	Imidazolinone “IMIs”	Beyond, Raptor	imazamox
		Cadre	imazapic
		Pursuit	imazethapyr
		Scepter	imazaquin
2	Sulfonylurea “SUs”	Accent	nicosulfuron
		Ally	metsulfuron
		Amber	triasulfuron
		Autumn	iodosulfuron
		Beacon	primisulfuron
		Classic	chloriumuron
		Express	tribenuron
		Glean	chlorsulfuron
		Harmony	thifensulfuron
		Maverick	sulfosulfuron
		Option	foramsulfuron
		Osprey	mesosulfuron
		Peak	prosulfuron
		Permit	halosulfuron
		Resolve	rimsulfuron
2	Triazolopyrimidine	FirstRate	cloransulam-methyl
		PowerFlex	pyroxsulam
		Python	flumetsulam
		Strongarm	diclosulam
2	Pyrimidinyl(thio)benzoate	Staple	pyrithiobac
2	Sulfonylaminocarbonyltriazolinones	Everest	flucarbazone
		Olympus	propoxycarbazone

Root Growth Inhibitors

Group	*Chemical family*	*Trade names*	*Active ingredient*
3	Dinitroaniline	Treflan, others	trifluralin
		Prowl, others	pendimethalin
		Sonalan	ethafluralin

Growth Regulators

Group	*Chemical family*	*Trade names*	*Active ingredient*
4	Phenoxy-carboxylic acid	many	2,4-D
		Butyrac, others	2,4-DB
			MCPA
4	Benzoic acid	Banvel, Clarity, Status, others	dicamba
4	Pyridine carboxylic acid	Stinger	clopyralid
		Starane	fluroxypyr
		Tordon[r], Grazon[r]	picloram
4	Quinoline carboxylic acid	Paramount	quinclorac

Photosynthesis Inhibitors (Photosystem II)

Group	*Chemical family*	*Trade names*	*Active ingredient*
5	Triazine	Aatrex[r], atrazine[r], others	atrazine
		Princep	simazine
		Caparol	prometryn
5	Triazinone	Sencor	metribuzin
		Velpar	hexazinone
5	Uracil	Sinbar	terbacil
6	Nitrile	Buctril, others	bromoxynil
6	Benzothiadiazinone	Basagran	bentazon
7	Urea	Linex, Lorox	linuron
		Karmex	diuron

Shoot Growth Inhibitors

Group	*Chemical family*	*Trade names*	*Active ingredient*
8	Lipid synthesis inhibitor, thiocarbamate	Eptam	EPTC
15	Chloroacetamide	Dual, Cinch, others	metolachlor
		Intrro[r], Micro-Tech[r]	alachlor
		Harness[r], Degree[r], Surpass[r], others	acetochlor
		Outlook	dimethenamid-P
15	Oxyacetamide	Define	flufenacet

Aromatic Amino Acid Synthesis Inhibitors

Group	*Chemical family*	*Trade names*	*Active ingredient*
9	Glycine	Roundup, Touchdown, others	glyphosate

Glutamine Synthesis Inhibitors

Group	*Chemical family*	*Trade names*	*Active ingredient*
10	Phosphonic acid	Ignite, Liberty	glufosinate

Pigment Synthesis Inhibitors

Group	*Chemical family*	*Trade names*	*Active ingredient*
12	Pyridazinone	Zorial Rapid 80	norflurazon
13	Isoxazolidinone	Command	clomazone
27	Triketone	Callisto	mesotrione
		Laudis	tembotrione
		Impact	topramezone
27	Isoxazole	Balance[r]	isoxaflutole

PPO Inhibitors

Group	*Chemical family*	*Trade names*	*Active ingredient*
14	Diphenylether	Blazer	acifluorfen
		Reflex, Flexstar	fomesafen
		Cobra	lactofen
		Goal	oxyfluorfen
14	N-phenylphthalimide	Valor	flumioxazin
		Resource	flumiclorac
14	Thiadiazole	Cadet	fluthiacet
14	Triazolinone	Aim	carfentrazone
		Spartan, Authority	sulfentrazone

Photosynthesis Inhibitors (Photosystem I)

Group	*Chemical family*	*Trade names*	*Active ingredient*
22	Bipyridilium	Gramoxone Inteon[r], others	paraquat
		Reglone, others	diquat

[r] Restricted use pesticide.

production. The list of herbicides in the accompanying table (found on the inside pages) is not exhaustive and does not account for herbicide premixes that contain two or more active ingredients. If you have questions regarding mode of action, consult the individual product label and support literature from the manufacturer or contact your county agricultural Extension educator for more information.

ACCase Inhibitors (Group 1)

Inhibitors of the ACCase enzyme in plants are used strictly for grass control. As a result, they are used primarily in broadleaf crops or fallow situations, but there are also some products labeled for use in grass crops to control specific grass weeds. These herbicides are commonly referred to by the nicknames of their chemical families, "FOPs," "DIMs," and "DENs."

ALS Inhibitors (Branched-Chain Amino Acid Inhibitors) (Group 2)

ALS inhibitors, or branched-chain amino acid inhibitors, comprise the largest mode of action and include at least one herbicide used in nearly every crop produced in Oklahoma. Many herbicides in this mode of action fall into two chemical families: imidazolinones (or "IMIs") or sulfonylureas (or "SUs"), but there are three other chemical families within the ALS inhibitors. Cross resistance, or herbicide-resistance to multiple chemical families within a single mode of action, is common with ALS inhibitors.

Root Growth Inhibitors (Group 3)

Herbicides in this mode of action inhibit cell division, which stops roots from extending and are distinctive because of the yellow color of their formulations. They are applied preplant incorporated or preemergence in a wide range of agronomic crops, vegetables, turf, and ornamentals for control of grasses and small-seeded broadleaf weeds.

Growth Regulators (Group 4)

This mode of action, also known as synthetic auxins, includes many commonly used plant hormone-type herbicides in wheat, corn, sorghum, and pasture settings. These herbicides are generally selective for broadleaf control in grass crops; however, there are some uses for preplant and in-season weed control in broadleaf crops.

Photosynthesis Inhibitors—Photosystem II (Groups 5, 6, and 7)

These herbicides inhibit Photosystem II, part of the photosynthesis pathway, and are used in a variety of crops for control of grass and broadleaf weeds. Because of their extensive use for several decades, some weeds have developed resistance to these herbicides, particularly atrazine and metribuzin.

Shoot Growth Inhibitors (Groups 8 and 15)

Herbicides in this mode of action are soil-applied herbicides and control weeds that have not emerged from the soil surface. These herbicides generally control grass weeds and small-seeded broadleaf weeds.

Aromatic Amino Acid Inhibitors (Group 9)

The only herbicide included in this mode of action is glyphosate. There are many generic glyphosate and glyphosate-containing products available. Depending on the product, glyphosate can be formulated as ammonium, diammonium, dimethylammonium, isopropylamine, and/or potassium salts. Despite the different salt formulations available, it is important to know that the type of salt formulation does not affect weed control, but rather it indicates the way a particular glyphosate product is formulated. Glyphosate is a generally a non-selective herbicide and will severely injure or kill any living plant tissue that it comes in contact with. However, it can be used selectively in glyphosate-resistant crops, including corn, soybean, cotton, and canola. Like the ALS inhibitors, glyphosate controls susceptible plants by inhibiting amino acid synthesis; however, glyphosate and ALS inhibitors control susceptible plants in completely different ways and should not be considered to be the same mode of action.

Glutamine Synthesis Inhibitors (Group 10)

The only herbicide included in this mode of action is glufosinate. Glufosinate can be used as a non-selective burndown treatment or as an over-the-top postemergence application in Liberty Link® crops (glufosinate resistant).

Pigment Synthesis Inhibitors (Groups 12, 13, 27)

These herbicides are also called "bleachers" because of the characteristic white plant tissue that develops in susceptible plants after application. Several of the pigment synthesis inhibitors (mesotrione, isoxaflutole) are also referred to as HPPD-inhibitors, based on their site of action.

PPO Inhibitors (Groups 14)

PPO inhibitors may also be referred to as cell membrane disruptors and are usually "burner"-type herbicides. Some PPO-inhibitors can be applied preemergence, but most are used for postemergence weed control.

Photosynthesis Inhibitors—Photosystem I (Group 22)

Photosystem I inhibitors include paraquat and diquat and are used for non-selective weed control and crop desiccation prior to harvest. These herbicides are also referred to as "cell membrane disruptors" because of their contact activity.

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OKLAHOMA STATE UNIVERSITY
AGRICULTURE
Horseweed Control
Suggestions In No-till Cotton
✓ Use an effective control strategy
Include 1.0 lb ai/acre - 2,4-D or 0.25 lb ai/acre - Dicamba
✓ Spray when weeds are small
-Rosettes are easiest to control
✓ Remember labeled plant back intervals
-30 days after 2,4-D;
-21 days after1″ rainfall following Dicamba*
*Do not apply Dicamba in regions receiving less than 25″ of average annual rainfall .
Don’t Let Horseweed Get the Jump on Your Cotton . . .
Start Clean and Stay Clean!

Horseweed Control with Zidua and Engenia for No-Till Cotton in Oklahoma

Introduction

This horseweed project focused on the use of two new or emerging products. Zidua is a newly registered herbicide from BASF. Zidua contains the active ingredient Pyroxasulfone. Pyroxasulfone is a group 15 (shoot inhibitor) herbicide providing preemergence or residual control of small-seeded broadleaf and annual grass weeds. Supplemental labeling for 2013 dictates that cotton may not be planted until 4 months have passed after the application of Zidua. This project was initiated in order to evaluate the efficacy of Zidua and to better define the tolerance of cotton to applications made closer to planting. Engenia is a new formulation of Dicamba. Though not currently available to growers, this formulation is expected to be labeled for the use over the top of Roundup Ready Extend cotton. Engenia contains 5 lb/gallon of the active ingredient Dicamba. Therefore use rates will be slightly less than traditional 4 lb products. This project was initiated in order to evaluate the effectiveness of Engenia on horseweed and to compare it to our current standards.

Materials and Methods

This study was established as a randomized complete block design with four replicates and was conducted on a clay loam soil in Tillman County. Broadcast over-the-top applications were made with a compressed air, high-clearance sprayer with a spray volume of 10 gallons per acre (GPA). Treatments were applied on April 1, 2013 utilizing both Zidua and Engenia. A total of ten treatments including an untreated control are listed in figure 1. Two treatments were applied according to OSU's standard recommendations for horseweed control. These were either 21 oz/A of 2,4-D (LV6) or 8 oz/A of Clarity in combination with 22 oz/A of Roundup Powermax. Any time Roundup powermax was applied, spray solutions were conditioned with 8.5 lbs/100 gal of spray grade ammonium sulfate before adding the Roundup Powermax. Engenia was applied with Roundup Powermax at the rate of 6.4 oz/A (equivalent ai to Clarity rate). In addition, both 2,4-D and Engenia were applied in three-way tankmixes with 2 oz/A of Zidua + either 1oz/A of Sharpen or + 0.5 lb ai/A Paraquat. Zidua was also applied with 0.5 lb ai/A paraquat alone. These treatments were also compared to a three way combination of Zidua + Sharpen + Roundup Powermax. The horseweed ranged from 3 to 6 inch rosettes at the time of application. Treatments were applied at 28 psi with flat fan nozzles.

1. **21 oz/A 2,4-D (LV6) + 22 oz/A Roundup Powermax***
2. **8 oz/A Clarity + 22 oz/A Roundup Powermax***
3. **6.4 oz/A Engenia + 22 oz/A Roundup Powermax***
4. **21 oz/A 2,4-D (LV6) + 2 oz/A Zidua + 1 oz/A Sharpen****
5. **21 oz/A 2,4-D (LV6) + 2 oz/A Zidua + 32 oz/A Paraquat (2lb)**
6. **6.4 oz/A Engenia + 2 oz/A Zidua + 1 oz/A Sharpen****
7. **6.4 oz/A Engenia + 2 oz/A Zidua + 32 oz/A Paraquat (2lb)**
8. **2 oz/A Zidua + 32 oz/A Paraquat (2lb)**
9. **2 oz/A Zidua + 1 oz/A Sharpen** + 22 oz/A Roundup Powermax***
10. **Untreated check**

*All RU trts included 8.5 lb/100 gal AMS
**All Sharpen trts included 8.5 lb/100 gal AMS and 1% v/v MSO

Figure 1. Horseweed treatments evaluated

Results and Discussion

Figure 2 provides the observed treatment performance at 7,14, 28 and 45 days after treatment (DAT). Engenia applied at 6.4 oz/A with Roundup Powermax (RU) controlled horseweed 70% when evaluated 7 days after treatment (DAT). This was similar to the performance of RU combinations including 2,4-D or Clarity (64-66%). As time passed control for all three RU combinations increased. Excellent horseweed control (98-100%) was observed from all three treatments by 45 DAT. All remaining treatments included either Sharpen or Paraquat and controlled horseweed 100% initially and this control held through the 45 day evaluation. Figure 3 presents control observed from applications of both Zidua and Engenia 30 DAT. This data validates the effectiveness of several chemical options for horseweed control when applications are made at the proper growth stage (rosette).

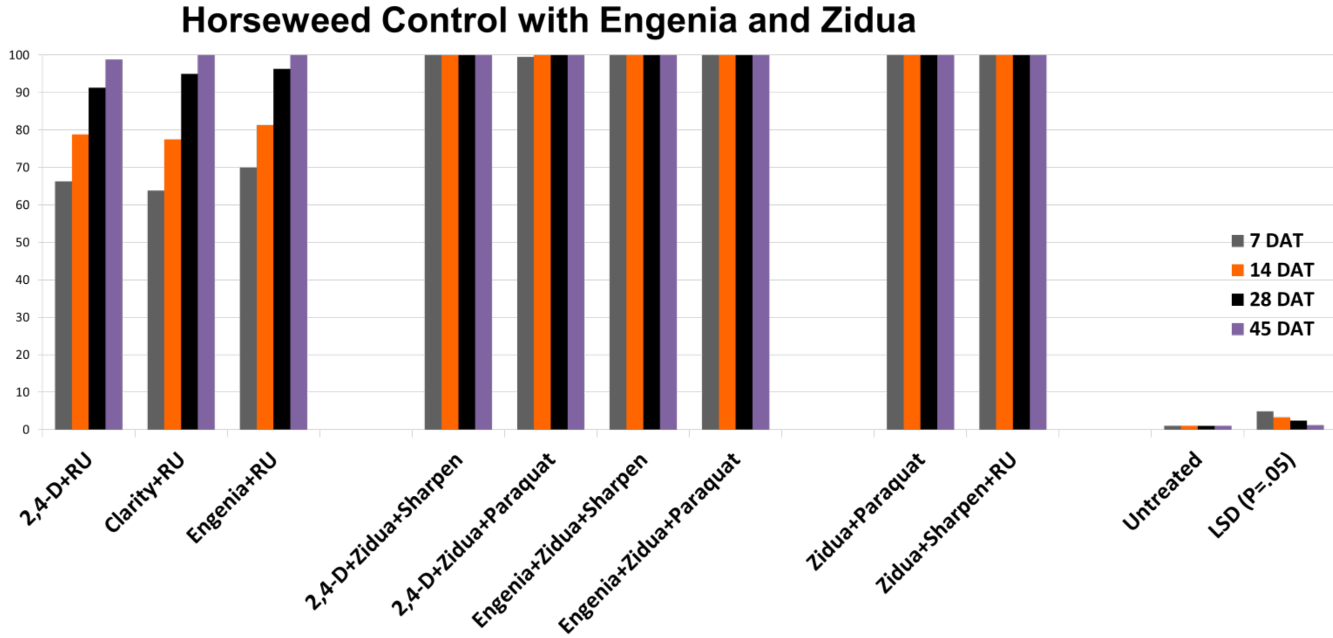


Figure 2. Treatment performance

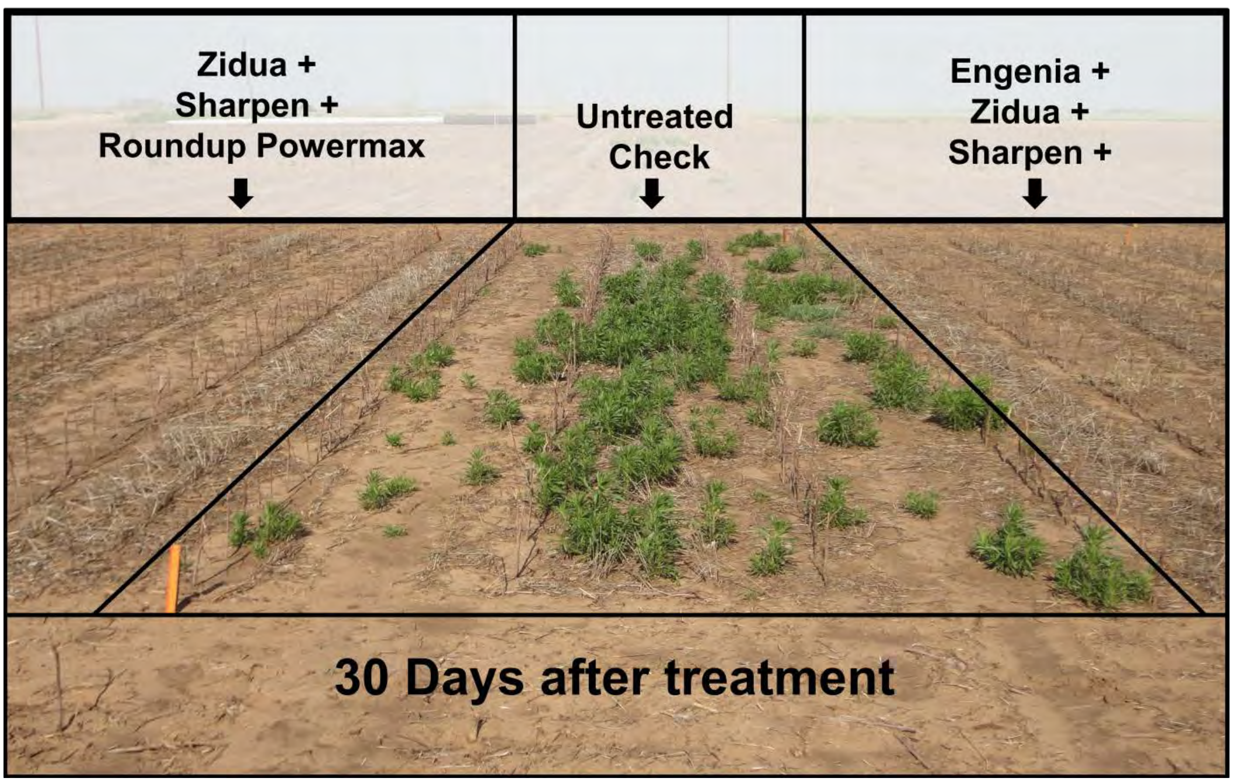


Figure3. Horseweed control provided by treatments including Zidua and Engenia.

How to Use Agweather's Drift Risk Advisor

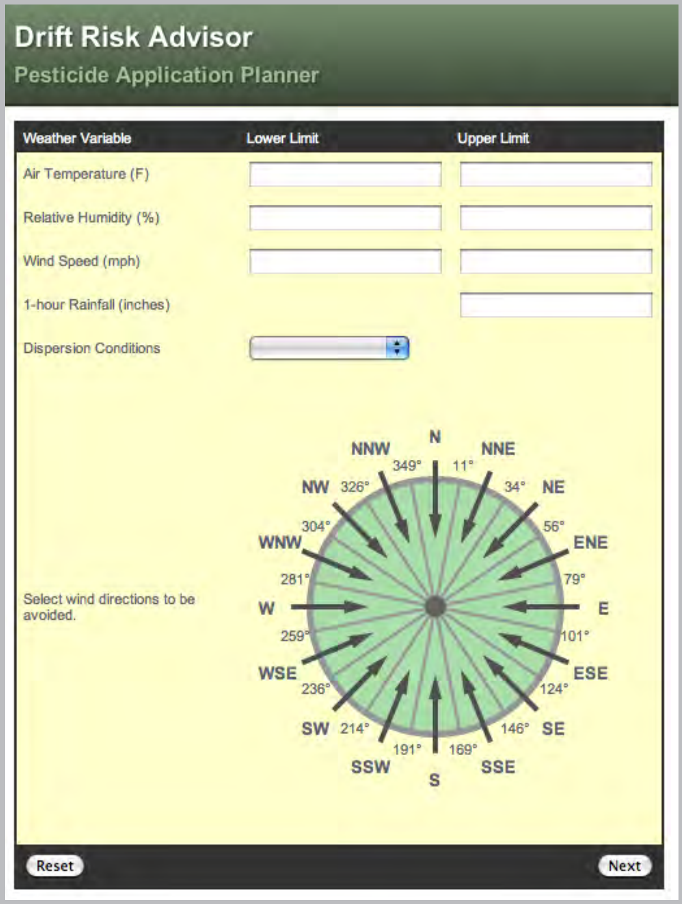
article revised November 2009

Introduction:

Spray applicators are faced with the challenge of avoiding spray drift. Spray drift is defined as "the output from an agricultural crop sprayer that is deflected out of the target area," typically caused by wind. Spray drift can be hazardous to sensitive plants and animals.

To aid applicators in identifying times of higher drift risk due to weather variables, the Oklahoma Mesonet has created a Drift Risk Advisor. This planning tool compares weather variable parameters with an 84-hour forecast matched to each Mesonet site. The Drift Risk Advisor uses the National Weather Service 84-hour North American Model forecast. In addition to weather variables the Drift Risk Advisor has forecasted dispersion conditions.

The Drift Risk Advisor is a weather-based planning tool that provides drift risk guidance, it does not supersede conditions at the field at the time of application that may be different from the forecast. The final judgement of whether conditions are appropriate for a spray application are the responsibility of the applicator.



Drift Risk Advisor Weather Variables:

Select "Upper" and "Lower Limits" that are appropriate for the application material. Upper and/or Lower Limits can be entered for one, all or any combination of the Drift Risk weather variables.

- Air temperature (Fahrenheit)
- Relative humidity (percent)
- Average wind speed (miles per hour)
- One hour rainfall (inches per hour)
- Wind direction
- Dispersion conditions

Dispersion conditions are based on the Oklahoma Mesonet Dispersion Advisor. Dispersion conditions are reported as one of six levels of vapor dispersion. These six categories are given text and number designations: Very Poor (1), Poor (2), Moderately Poor (3), Moderately Good (4), Good (5) and Excellent (6).

Finding the Drift Risk Advisor:

The Oklahoma Mesonet Drift Risk Advisor is located on the Agweather Web site (**http://agweather.mesonet.org**).

- From the main Agweather page, select "**Forecast**"
  - Choose "**Drift Risk Advisor**"

or

- From the main Agweather page, select "**Crop**"
  - Choose any crop
    - Under Pest Control, select "**Drift Risk Advisor**"

or

- From the main Agweather page, select "**Horticulture**"
  - Choose any horticulture crop
    - Under Pest Control, select "**Drift Risk Advisor**"

AGWEATHER

Drift Risk Advisor

Pesticide Application Planner

Date and Time	Criteria Met?	Wind Direction	Wind Direction in degrees	Wind Speed	Air Temperature	Rainfall per Hour	Dispersion Conditions	Relative Humidity
Nov 13, 2009 3:00 pm CST	Yes	SSW	194.7	4 mph	77°F	0.00 in.	5 (G)	36%
Nov 13, 2009 4:00 pm CST	Yes	S	176.7	3 mph	74°F	0.00 in.	4 (MG)	46%
Nov 13, 2009 5:00 pm CST	Yes	SE	143.5	2 mph	70°F	0.00 in.	3 (MP)	56%
Nov 13, 2009 6:00 pm CST	No	ESE	107.2	2 mph	66°F	0.00 in.	1 (VP)	65%
Nov 13, 2009 7:00 pm CST	No	SE	125.3	2 mph	65°F	0.00 in.	1 (VP)	68%
Nov 13, 2009 8:00 pm CST	No	SE	141.4	3 mph	64°F	0.00 in.	2 (P)	71%
Nov 13, 2009 9:00 pm CST	No	SSE	153.7	3 mph	63°F	0.00 in.	2 (P)	74%
Nov 13, 2009 10:00 pm CST	No	SSE	160.6	2 mph	61°F	0.00 in.	1 (VP)	78%
Nov 13, 2009 11:00 pm CST	No	SSW	194.5	1 mph	59°F	0.00 in.	1 (VP)	82%

Drift Risk Advisor Output Table:

The times when Weather Variables are within the user entered "**Upper and Lower Limits**" will appear as green colored boxes in the output table. When the Weather Variable is outside the Upper and Lower Limits, the box will have a red color. Weather Variables not compared will be shown in the table as column(s) of alternating gray and white boxes.

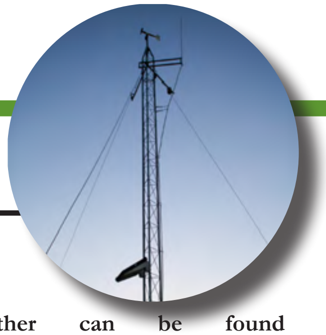
When all selected "**Weather Variables**" for a single hour fall within the entered Upper and Lower Limits, the "**Criteria Met?**" box will be colored green and have "**Yes**" text. When any one Weather Variable for a single hour falls outside the entered Upper and Lower Limits, the box in the "**Criteria Met?**" column will have a red color and "**No**" text.

Examples of Drift Caution Statements on Pesticide Labels

Trade name	Common name	Pesticide group	Drift caution statements
Banvel + 2,4-D	Banvel and 2,4-D	Hormone herbicide	Do not spray near sensitive plants if wind is gusty or in excess of 5 mph and moving in the direction of adjacent sensitive crops
Command 3ME	Clomazone	Preemergecy herbicide	Do not apply in winds about 10 mph. Avoid gusty or windless conditions
Dimethoate 4E	Dimethoate	Organophosphate insecticde	Apply only when the wind is less than or equal to 10 mph
Tordon 22K	Picloram	Hormone herbicide	Drift potential is lowest between wind speeds of 2-10 mph. Application should not occur during an inversion because drift potential is high.
Trigard	Cyromazine	Insect growth regulator	To avoid spray drift, do not apply under windy conditions
Warrior	Lambda-cyhalothrin	Synthetic pyrethroid insecticde	Do not apply when wind velocity exceeds 15 mph.

Your feedback is important to us. Call us at 405-325-3126.

Our story



In 1982, Oklahoma scientists recognized the need for a statewide weather network.

At OSU, agricultural scientists wanted to upgrade weather instruments at their research sites. Their goal was to expand the use of weather data in agricultural applications.

Meanwhile, scientists from OU and the Oklahoma Climatological Survey were helping to plan and implement a flood-warning system for Tulsa.

OSU and OU joined forces in 1987 when they realized that one statewide weather network would help both universities achieve their missions.

No other state or nation is known to have a network that boasts the capabilities of the Oklahoma Mesonet.

Agweather is one Web site that features data from the Oklahoma Mesonet. Agweather provides weather-related products for agriculture and natural resources.

Agweather can be found at http://agweather.mesonet.org/.

Agweather
LOCAL. RELIABLE. FREE.

Oklahoma Mesonet

Entomology & Plant Pathology

Outreach – NTOKcotton.org, cotton.okstate.edu, eXtension Cotton Community of Practice, Cotton Comments Newsletter, and Texas Cotton Resource DVD

The NTOK (North Texas, Oklahoma, and Kansas) program and website (www.ntokcotton.org) , was maintained for the Oklahoma Cotton Council. This was supported by generation of timely information on important issues during the growing season. Mr. Vic Schoonover provided 10 Talkin' Cotton articles for release to local newspapers and these were also posted to the ntokcotton.org website. Due to a shortage of funds by the Oklahoma Cotton Council, no additional Talkin' Cotton articles were generated after July, 2013. Based on results from ipower.com website traffic analysis software for the ntokcotton.org website, from January 1 through December 31, 2013, the number of unique visitors was 6,152. The total number of visits was 36,190, number of page downloads was 50,756, and total hits was 61,808.

The OSU Extension Cotton Team developed eleven newsletters which were published and emailed directly to 326 recipients. A total of 53 recipients responded to an end-of-season survey. It was evident based on this survey and respondents, that an additional 387 people were forwarded the newsletter. Therefore, the best estimate we have for direct distribution of the newsletter is a total of 7,843 (11 editions x 713 recipients). These newsletters were also published to the websites cotton.okstate.edu and ntokcotton.org. Survey questions were asked pertaining to the value and content of the newsletters. Recipients were asked to rate on a scale of 1 to 5 (1 being not very useful) and 5 (being extremely useful). The result for the newsletter's usefulness was 4.44. With respect to the question of "topics being timely and discussed" the result was 4.44. When asked whether the newsletter should be continued the result was 100% of respondents.

We placed considerable content on the www.cotton.okstate.edu website hosted by a campus server since it was initiated in 2012. We supported this website with our publications and newsletters. This website has a great appearance and we have provided various information tabs containing content or links for the following areas: Cotton Team, Cotton Comments Newsletters, Cotton Extension Annual Reports, Extensive Production Information Links, Variety Tests, Budgets, Irrigation, Sprayer Calibration, Weed Control, Weed Resistance Management, Plant Growth Regulators, Plant Growth and Development, Fertility, Insect Management, Diseases, Yield Estimation, Harvest Aids, Harvesting and Ginning, Fiber Quality, Crop Insurance, No-till Production, Producer Organization Links, Seed and Trait Company Links, Oklahoma Mesonet Tools, and Journal of Cotton Science.

Several years ago cotton specialists from across the Belt participated in conference calls and a meeting in Kansas City to establish the eXtension cotton website. We provided numerous numbered publications to upload to the Website. It was launched at the Beltwide Cotton Conference in Nashville in January, 2008. In 2012, this was still actively supported by our Beltwide Extension Cotton Specialist Working Group, a true multi-state research and extension effort. Dr. Boman is the subject matter editor for the Ginning and Classing section for the

Cotton Community of Practice. All subject matter sections were updated in the fall of 2012 by the various editors. Dr. Guy Collins of the University of Georgia is handling coordination of content updating. We have a direct link on both websites we manage. This website can be found at www.extension.org.

Included in Oklahoma State Support-Cotton Incorporated funding for 2012 was the acquisition of 500 copies of the 2011 Texas Cotton Resource DVD. We worked with Dr. Gaylon Morgan, State Extension Cotton Specialist with Texas A&M AgriLife Extension Service, and were successful in acquiring these DVDs. In addition to copies initially distributed in 2012, more copies were distributed at various meetings during 2013. We will continue to distribute this DVD during subsequent meetings in the state until the supply is exhausted.

Surveys of Crop and Pest Conditions

From the IPM perspective, grasshoppers were the main concern of the 2013 crop. Population was heavy and prolonged but control issues were a concern. Insecticide sprays were generally limited. Early thrips pressure did not develop but cotton fleahopper populations were present. Where insecticide applications were used no control issues developed. Stink bugs and leaf footed bugs appeared late but were confined to areas under adequate irrigation. Cotton bollworm populations were discovered in some of the few non Bt fields but none were reported elsewhere. Overall, the 2013 crop year was one of lightest insect infestations year in memory. Population trends, insect updates, and control tips were published in the Cotton Comments Newsletter and distributed to the state's cotton producers and consultants to help formulate management strategies to enhance profitability. Field surveys were conducted in 9 counties with a total of 20 fields. Insect pressure as well as plant development was recorded and reported in the newsletter. As part of the COTMAN program, nodes above white flower (NAWF) criterion was tracked at each location to assist producers in the identification of the last cohort of bolls that should likely make harvestable lint at each site. This assists with the termination of insecticides for late season pests, and helps determine irrigation termination and harvest aid application dates.

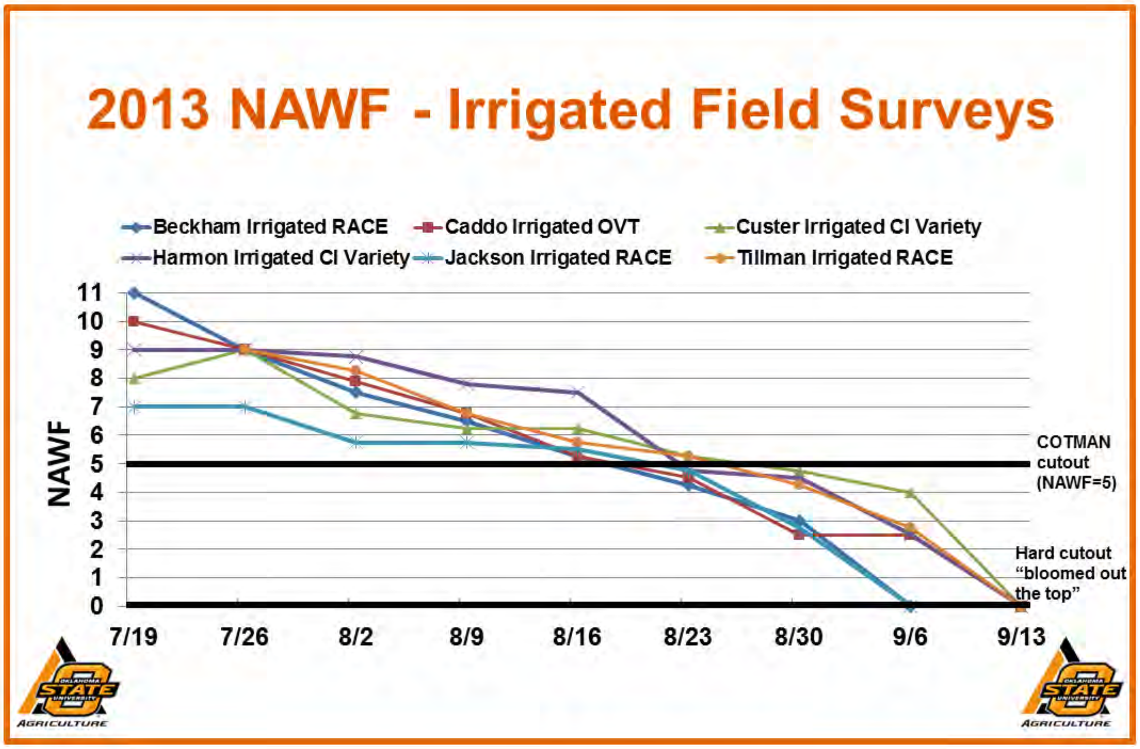


Figure 1. Weekly nodes above white flower (NAWF) in surveyed irrigated fields in 2013.

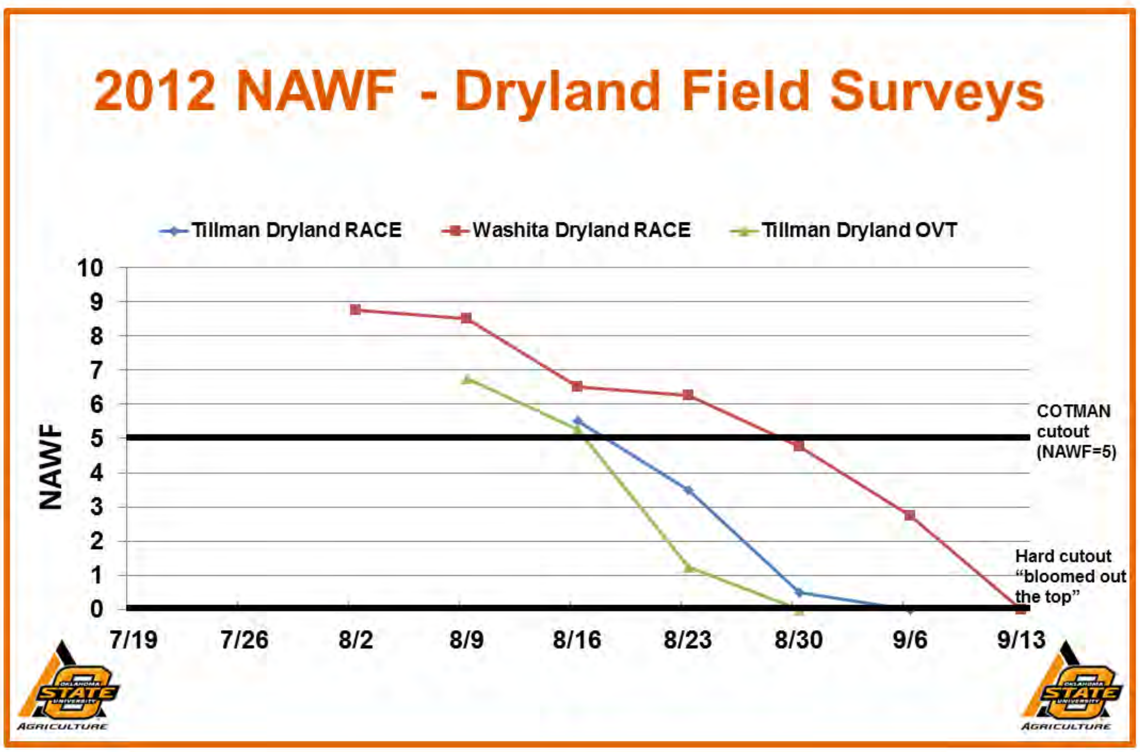


Figure 2. Weekly nodes above white flower (NAWF) in surveyed dryland fields in 2013.

Research Accomplishments

Cotton Bollworm / Tobacco Budworm and Beet Armyworm Monitoring

The bollworm/tobacco budworm complex has historically been the target of annual insecticide applications in Oklahoma cotton. Monitoring moth activities helps determine species ratio and the potential peak ovipositional activity for these insects. Traps were located near the communities of Altus, Ft Cobb, Hollis, Texola and Tipton. In addition to Heliothine activity, beet armyworm catches were also monitored at each location. Traps were maintained between June 1 and October 1, 2013. Although both Heliothine species do coexist and are considered the same by growers, the species ratio is important since tobacco budworms exhibit a higher level of resistance to insecticides than bollworms. Also, it would be important to know this ratio in the event of Bt cotton failures. It is extremely important to detect fluctuations in species ratio of each ovipositional period and adjust insecticide recommendations accordingly for non-Bt cotton fields. A total of 1,066 moths were captured between the weeks of June 1 and October 1. Bollworms comprised 83.67% of the total catch in 2013. Beet armyworm moth catches were extremely light.

Table 1. Moth Pheromone Trap Catch Totals for Selected Regions of Oklahoma, Summer 2013.

	Altus	Tipton	Hollis	Ft. Cobb	Delhi
Bollworm	183	232	227	122	128
Tobacco Budworm	25	49	62	18	20
Beet Armyworm	91	113	89	142	150

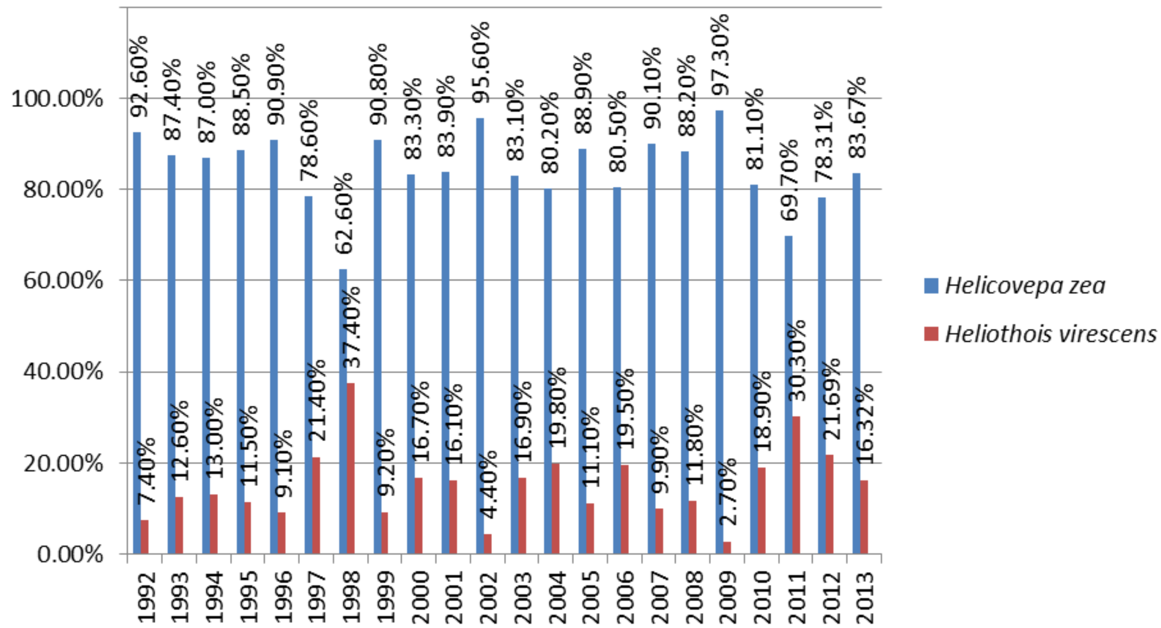


Figure 3. Species composition of moths trapped across Oklahoma, Summer 2013.

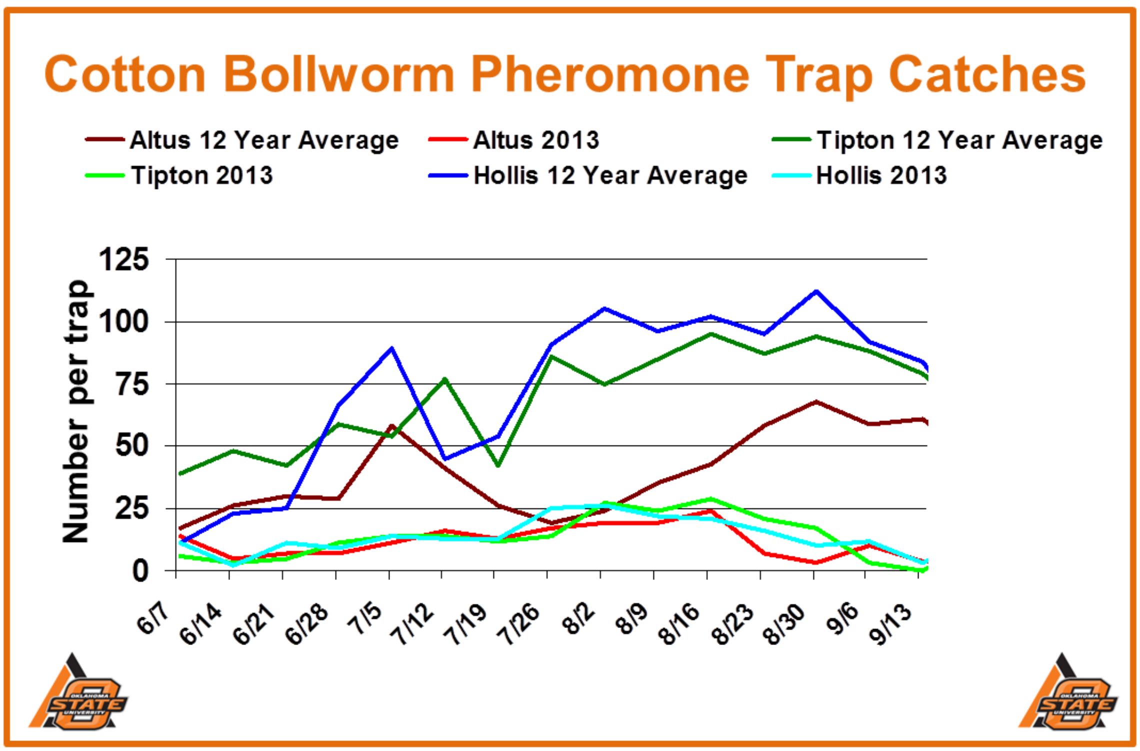


Figure 4. Cotton bollworm moths trapped by week across Oklahoma, Summer 2013.

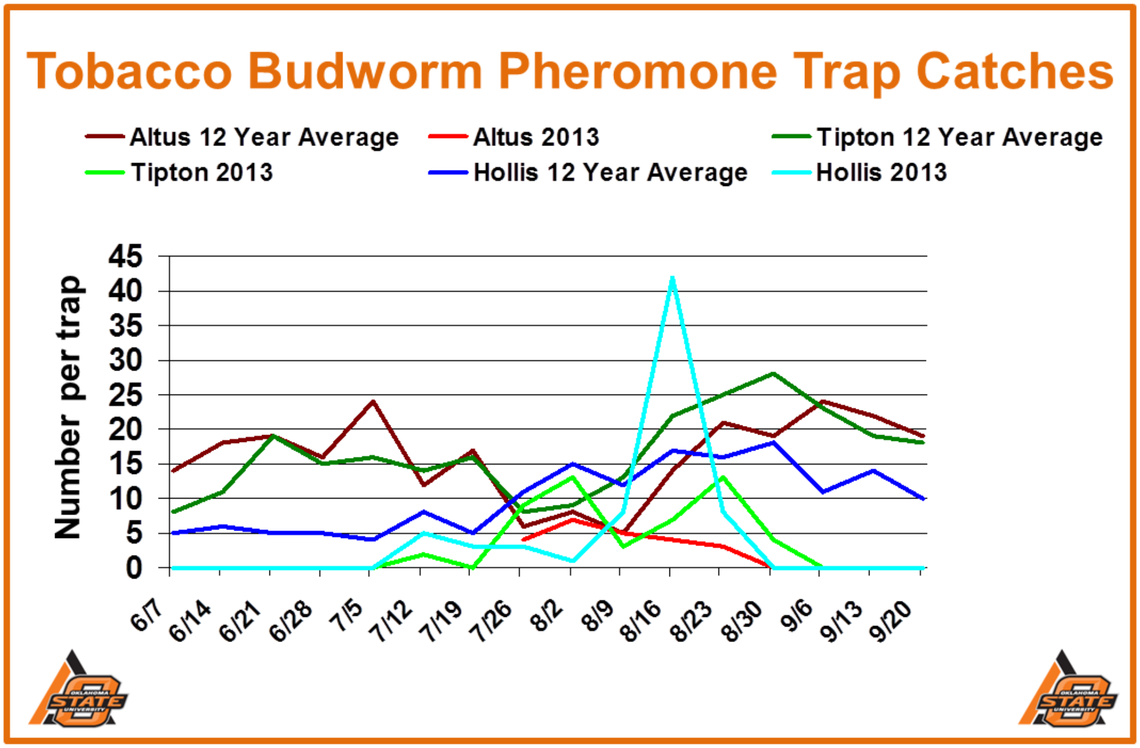


Figure 5. Tobacco budworm moths trapped by week across Oklahoma, Summer 2013.

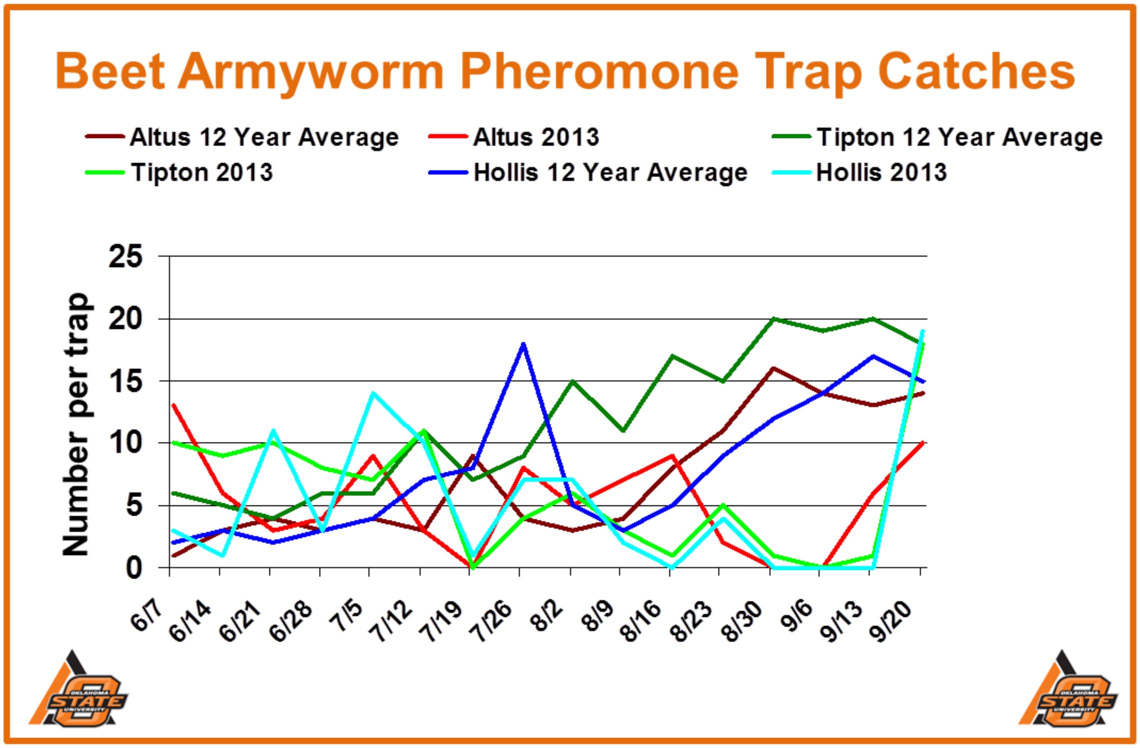


Figure 6. Beet armyworm moths trapped by week across Oklahoma, Summer 2013.

Insecticide Evaluation Trials

Four insecticide product evaluation trials were attempted but due to poor soil moisture all sites no yield data was collected. The Jackson County locations included irrigated trials. However, insufficient water in Lake Lugert resulted in no water being released for irrigation purposes. The Tillman county locations were dryland and with the harsh conditions the site failed to produce harvestable yield.

Bayer CropSciences' TwinLink Bt Observation Trials – Important Tool in Cotton Insect Resistance Management

Working with industry, we initiated two Cotton Agronomic Performance (CAP) trials with Bayer CropScience's proprietary TwinLink technology targeted to control various lepidopterous pests. Although still sourced from Bt, it is a different system than what is currently marketed by Monsanto (Bollgard II, Cry1A + Cry2AB) and Dow AgroSciences (Widestrike, Cry1A + Cry1F). TwinLink (consisting of genes to express Cry1Ab and Cry2Ae proteins) was approved by EPA and USDA in 2013, but at planting time, the company was still waiting for ex-U.S. approval by trading partners. The objective of these trials was to evaluate TwinLink technology in some germplasm lines likely to be sold in 2014. These trials were conducted under a stewardship agreement with Bayer CropScience and were planted in producer-cooperator irrigated fields in Harmon and Blaine Counties. TwinLink Bt was effective in controlling low populations of lepidopterous pests encountered at the sites in 2013.

Evaluation of Flutriafol for Cotton Root Rot Control and Section 18 Request

As part of an overarching IPM responsibility, two *Phymatotrichopsis* (or cotton) root rot (PRR) control trials evaluating Topguard (flutriafol) were established in Kiowa (irrigated) and Tillman (dryland) counties. PRR is caused by the fungus *Phymatotrichopsis omnivora*. Once infected, cotton is rapidly killed by this disease. As a result, yield is severely reduced, and harvesting efficiency declines due to dead stalks becoming entangled in harvester row units, particularly with stripper-type machines.

The project results were presented at 2014 Cotton Beltwide in New Orleans, LA. The Tillman County dryland site failed due to drought. Substantial but spatially variable PRR pressure was encountered at the Kiowa County irrigated site. Results indicated that 0.13 and 0.26 lb/acre flutriafol rates had lower percentage diseased plants than the untreated. The 0.26 lb/acre rate resulted in a lower percentage of diseased plants than the 0.13 lb rate. Although no differences were noted with respect to percentage of diseased plants, the Topguard formulation provided greater lint yield than the CHA-1328 product, the reasons for which are unclear. When compared to the modified in-furrow treatment, T-band application method resulted in a higher number of healthy plants at both 14 and 28 DAP, but this did not result in higher yield at harvest. Lint yields were 1226, 1566, and 1715 lb/acre for the untreated check, and flutriafol rate main effect means of 0.13 and 0.26 lb a.i./acre, respectively. When compared to the untreated check, yields were increased by 340 and 489 lb/acre for the 0.13 and the 0.26 lb a.i./acre rates, respectively. This represents 28 and 40 percent yield increases for flutriafol rates of 0.13 and 0.26 lb a.i./acre, respectively, when compared to the untreated check. Results from this project indicate that flutriafol was effective at reducing the negative impact of PRR at this site.

Using results from the Kiowa County site, a Section 18 request was made through Dr. Jackie Lee and Dr. John Damicone to the Oklahoma Department of Agriculture, Food and Forestry in early February. This follows Texas' 2012, 2013, and 2014 successful Section 18 requests for flutriafol for cotton root rot control.

Counties in the Section 18 request include Comanche, Cotton, Kiowa, and Tillman. Based on 2013 cotton plantings in these counties, this would potentially affect a maximum of about 50,000 acres (see www.obweo.org/County%20Statistics.htm). It is very likely that a substantially lower number of acres would potentially be treated with this product, because not all fields in those counties have disease pressure. We are optimistic that this request will be successful. For more information on flutriafol see the Beltwide Cotton Conference Proceedings article "Field Evaluation of Topguard (Flutriafol) for Cotton Root Rot Management in Oklahoma.

COTTON INSECT LOSSES 2013

This report is sponsored by a grant from the Cotton Foundation.

Michael R. Williams, Chairman
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Highlights

Cotton losses to arthropod pests reduced overall yields by 2.68%. Lygus were the top ranked pest in 2013 reducing yields by 0.782%. Stink bugs were ranked second at 0.684%. Thrips were ranked third at 0.553%. Cotton fleahoppers were fourth at 0.217%. Bollworm/budworm complex caused 0.161% loss and spider mites reduced yields by 0.133%. No other pest exceeded 0.1% loss. Total costs and loss for insects in 2013 were $724.2 million. Direct management costs for arthropods were $62.70 per acre.

Table 1. Oklahoma Cotton Insect Losses – 2013.

Pest	acres infested	acres treated	#apps/ acre trtd	#apps/ tot acres	cost/ acre	%red	Bales lost
Boll Weevil	0	0	0	0.000	$0.00	0.00%	0
Bollworm/Budworm	0	0	0	0.000	$0.00	0.00%	0
Pink Bollworm	0	0	0	0.000	$0.00	0.00%	0
Cotton Fleahopper	68,840	60,235	1	0.350	$3.15	0.60%	1,952
Lygus	0	0	0	0.000	$0.00	0.00%	0
Cotton Leaf Perforator	0	0	0	0.000	$0.00	0.00%	0
Spider Mites	0	0	0	0.000	$0.00	0.00%	0
Thrips	77,445	17,210	1	0.100	$0.20	0.23%	732
Beet Armyworm	0	0	0	0.000	$0.00	0.00%	0
Fall Armyworm	0	0	0	0.000	$0.00	0.00%	0
European Cornborer	0	0	0	0.000	$0.00	0.00%	0
Stink Bugs	8,605	27,426	1	0.010	$0.09	0.00%	2
Grasshoppers	146,285	60,235	1	0.350	$3.85	0.04%	138
Saltmarsh Caterpillars	0	0	0	0.000	$0.00	0.00%	0
Aphids	0	0	0	0.000	$0.00	0.00%	0
Banded Winged Whitefly	0	0	0	0.000	$0.00	0.00%	0
Silverleaf Whitefly (Bemesia)	0	0	0	0.000	$0.00	0.00%	0
Loopers	0	0	0	0.000	$0.00	0.00%	0
Southern Armyworms	0	0	0	0.000	$0.00	0.00%	0
Cutworms	0	0	0	0.000	$0.00	0.00%	0
Clouded Plant bugs	0	0	0	0.000	$0.00	0.00%	0
Other	0	0	0	0.000	$0.00	0.00%	0
Other	0	0	0	0.000	$0.00	0.00%	0
Other	0	0	0	0.000	$0.00	0.00%	0
Other	0	0	0	0.000	$0.00	0.00%	0
Other	0	0	0	0.000	$0.00	0.00%	0
				0.810	$7.29	0.87%	2,824

Yield & Management Results	
Total Acres	172,100
Total bales Harvested	215,125
yield (lbs/acre)	600
Total bales Lost to Insects	2,824
Percent Yield Loss	0.87%
Yield w/o Insects (lbs/ac)	605
Ave. # Spray Applications	0.81
Bales lost all factors	110,171
% yield loss all factors	33.87%

Economic Results	**Total**	**Per Acre**
Foliar Insecticides Costs	$1,254,609	$7.29
At Planting Costs	$1,060,566	$6.16
In-furrow costs	$37,862	$0.22
Scouting costs	$167,798	$0.98
Eradication costs	$344,200	$2.00
Transgenic cotton	$1,448,979	$8.42
Total Costs	$4,314,013	$25.07
Yield Lost to insects	$1,016,486	$5.91
Total Losses + Costs	$5,330,500	$30.97

COTTON DISEASE LOSS ESTIMATE COMMITTEE REPORT, 2013

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Abstract

The National Cotton Council Disease Loss committee submitted estimates of the losses due to each disease during the 2013 growing season. Estimates are calculated by cotton specialists in each state discussing disease incidence observed across each state during the year. Yield losses are determined by using the USDA "Crop Production" published at www.usda.gov/nass/PUBS/TODAYRPT/crop1113.pdf which documents cotton acreage planted, harvested, and average yields for each state. Total average percent loss was estimated at 12.54% which is up 3.35% from 2012. Plant parasitic nematodes were the group of pathogens responsible for the largest average percent loss estimated at 4.98% up from the 4.28% in 2012. Georgia and Alabama suffered the greatest disease losses of over 20 %; although these states were followed closely by Tennessee, Mississippi, and Missouri which estimated losses near 15%. Oklahoma, New Mexico, and California appeared to have the best growing conditions with the least amount of disease losses.

	Table 1. Cotton disease loss estimates for the 2013 season.																		
	Percent disease loss estimates	AL	AZ	AR	CA	FL	GA	LA	MS	MO	NM	NC	OK	SC	TN	TX	VA	Bales lost	% Bales lost
2013	Fusarium Wilt (F.o. vasinfectum)	0.5	0.0	0.0	1.2	0.0	trace	1.0	trace	0.1	0.0	0.0	0.0	2.0	0.0	0.3	0.0		0.29
2013	*Bales lost to Fusarium (x 1,000)*	3.1	0.0	0.0	10.9	0.0	0.0	3.4	0.0	0.5	0.0	0.1	0.0	7.0	0.0	12.3	0.0	37.4	
2013	Verticillium Wilt (V. dahliae)	1.5	1.5	1.5	0.2	0.0	0.0	0.0	trace	0.1	1.0	0.0	0.4	0.0	0.0	1.5	0.0		0.71
2013	*Bales lost to Verticillium (x 1,000)*	9.3	7.1	10.5	1.4	0.0	0.0	0.0	0.0	0.5	0.9	0.1	0.7	0.0	0.0	61.7	0.0	92.2	
2013	Bacterial Blight (X. malvacearum)	0.0	0.0	0.5	0.0	0.0	trace	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	trace	0.0		0.04
2013	*Bales lost to Xanthomonas (x 1,000)*	0.0	0.0	3.5	0.0	0.0	0.0	0.0	1.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.9	
2013	Root Rot (P. omnivora)	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	4.0	0.0		1.32
2013	*Bales lost to Phymatotrichopsis (x 1,000)*	0.0	7.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	164.6	0.0	171.9	
2013	Seedling Diseases (Rhizoctonia & Etc.)	6.0	0.5	2.5	1.0	0.2	2.5	1.0	2.5	5.0	0.5	2.0	0.2	1.0	10.0	0.8	1.0		2.08
2013	*Bales lost to Seedling disease (x 1,000)*	37.2	2.4	17.5	9.1	0.5	62.5	3.4	16.8	26.3	0.5	15.2	0.3	3.5	43.0	32.9	1.6	272.5	
2013	Ascochyta Blight (A. gossypii)	0.6	0.0	0.0	0.0	2.0	trace	0.0	trace	0.0	0.0	0.0	0.0	0.3	0.5	0.0	0.0		0.09
2013	*Bales lost to Ascochyta (x 1,000)*	3.7	0.0	0.0	0.0	4.5	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.9	2.2	0.0	0.0	11.4	
2013	Boll Rots (Rhizopus, etc.)	4.0	0.1	1.0	trace	4.0	3.0	1.0	2.0	8.0	0.0	3.0	0.0	0.3	1.0	0.6	0.1		1.74
2013	*Bales lost to Rhizopus (x 1,000)*	24.8	0.5	7.0	0.0	9.0	75.0	3.4	13.4	42.0	0.0	22.8	0.0	0.9	4.3	24.7	0.2	227.9	
2013	Nematodes (All)	5.0	3.0	4.0	0.1	4.0	13.0	6.0	8.6	1.0	0.5	4.0	0.1	6.0	3.0	2.2	3.0		4.99
2013	*Bales lost to Nematodes (x 1,000)*	31.0	14.2	28.0	0.9	9.0	325.0	20.4	57.6	5.3	0.5	30.4	0.2	21.0	12.9	90.6	4.8	651.7	
2013	Nematodes (Meloidogyne spp.)	1.0	3.0	2.0	0.0	3.0	10.0	2.0	1.5	1.0	0.5	3.0	0.1	4.0	0.0	1.9	2.0		3.31
2013	*Bales lost to Meloidogyne (x 1,000)*	6.2	14.2	14.0	0.0	6.8	250.0	6.8	10.1	5.3	0.5	22.8	0.2	14.0	0.0	78.2	3.2	432.1	
2013	Nematodes (Reniform reniformis)	4.0	0.0	2.0	0.0	1.0	2.5	4.0	6.6	0.0	0.0	0.5	0.0	1.0	3.0	0.3	0.0		1.48
2013	*Bales lost to Reniform (x 1,000)*	24.8	0.0	14.0	0.0	2.3	62.5	13.6	44.2	0.0	0.0	3.8	0.0	3.5	12.9	12.3	0.0	193.9	
2013	Nematodes (Other spp.)	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	0.0	0.5	0.0	1.0	0.0	0.0	1.0		0.19
2013	*Bales lost to other Nematodes (x 1,000)*	0.0	0.0	0.0	0.0	0.0	12.5	0.0	3.4	0.0	0.0	3.8	0.0	3.5	0.0	0.0	1.6	24.8	
2013	Leaf Spots & Others	3.0	0.0	0.5	0.0	2.5	4.5	0.5	1.5	0.1	0.0	1.0	0.2	0.1	0.5	0.2	0.1		1.31
2013	*Bales lost to Leaf spots & Others (x 1,000)*	18.6	0.0	3.5	0.0	5.6	112.5	1.7	10.1	0.5	0.0	7.6	0.4	0.4	2.2	8.2	0.2	171.4	
2013	Total Percent Lost	20.6	6.6	10.0	2.5	12.7	23.0	9.5	14.8	14.3	2.0	10.0	0.9	9.6	15.0	9.6	4.2		12.56
2013	Total Bales Lost (x 1,000)	127.7	31.2	70.0	22.3	28.6	575.0	32.3	99.2	75.1	2.3	76.3	1.8	33.6	64.5	395.1	6.7	1641.8	
2013	Total Yield in Bales (x 1,000) (USDA Nov'13)	620.0	472.5	700.0	910.0	225.0	2500.0	340.0	670.0	525.0	92.0	760.0	200.0	350.0	430.0	4116.0	160.0	13070.5	

Comments:

AL Warm dry spring with rainfall in late June and July and a very dry late summer and fall. Nematode damage was greater especially on irrigated land. Fusarium wilt was lower while Verticillium wilt incidence increased. Corynespora leaf spot was found most often in the coastal areas.

GA Very warm spring and wet season with significant increase in damage to nematodes, boll rot and Target/Corynespora leaf spot.

NC Excessive rainfall in July with many field sitting in water.

OK Lack of water was their biggest problem.

SC A very wet June, July, and first half of August. Many fields sat in water for weeks on end. We had more seedling disease, but not as much as you might think. Fusarium and root-knot seem to be higher. Corynespora leaf spot was present, but not nearly as bad.

Harvest Aids

In addition to the variety testing work, we initiated several demonstrations and two trials to test various new cotton inputs. One replicated trial in particular focused on the use of three products, ETX, Sharpen and Display. These results were presented at the Beltwide cotton conference and are presented in the Beltwide Conference Proceedings section of this report. A replicated Bayer CropScience harvest aid protocol was also implemented. This trial investigated the utility of cyclanilide (AE0195157) as a tank mix with various harvest aid products. Four replicates of harvest aid treatments were applied at 60% open bolls on September 25 in a field adjacent to the Tillman County furrow irrigated RACE trial. Results indicated that at 7 days after treatment (DAT), visually estimated defoliation was enhanced by cyclanilide addition to Ginstar, but not with Adios, a generic product similar to Ginstar (Table 1~~).~~ At 7 DAT, visually estimated open boll percentage was similarly improved by all chemical treatments when compared to the untreated check. By 14 DAT, defoliation improved considerably for all chemical treatments when compared to the untreated. However, Ginstar and Ginstar + AE0195157 had similar 14 DAT defoliation levels, and the Adios + AE0195157 treatment still lagged behind these treatments. Terminal and basal regrowth were highly variable in the trial, and although significant differences were noted among treatments, these had little practical value.

				10/2/2013		10/2/2013		10/9/2013		10/9/2013		10/17/2013		10/17/2013	
				Defoliation		Open Bolls		Defoliation		Open Bolls		Terminal Regrowth		Basal Regrowth	
Trt			Rate	%		%		%		%		%		%	
No.	Treatment	Rate	Unit	7 DAT		7 DAT		14 DAT		14 DAT		21 DAT		21 DAT	
1	Untreated			0.0	f	55.5	b	0.0	e	85.0	b	0.0	c	0.0	c
2	Finish 6 Pro	21	OZ/A	40.0	c	76.3	a	56.3	c	96.8	a	23.8	ab	25.0	a
3	AE 0195157	5	OZ/A	16.9	e	73.3	a	46.7	d	96.0	a	15.0	bc	12.5	b
3	Prep	16	OZ/A												
4	Ginstar	6	OZ/A	65.0	b	72.3	a	85.0	a	96.3	a	25.0	ab	25.0	a
5	Ginstar	6	OZ/A	81.3	a	79.3	a	91.3	a	96.3	a	21.3	b	32.5	a
5	AE 0195157	5	OZ/A												
6	AE 0195157	7.5	OZ/A	28.8	d	70.8	a	50.0	cd	95.5	a	21.3	b	25.0	a
6	Prep	24	OZ/A												
7	Adios	6	OZ/A	45.0	c	71.5	a	72.5	b	95.5	a	37.5	a	26.3	a
7	AE 0195157	5	OZ/A												
Pr>F				0.0001		0.0224		0.0001		0.0002		0.0070		0.0001	
LSD (P=.05)				8.5		12.3		7.0		4.3		16.2		10.9	
CV, %				14.4		11.6		8.2		3.0		53.0		35.1	
Means followed by same letter do not significantly differ (P=.05, LSD)															
Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.															

Table 1. Cyclanalide tank-mix strategies for defoliation.

Three harvest aid demonstrations were initiated adjacent to the Tillman County furrow irrigated RACE trial (September 25), the Jackson County furrow irrigated RACE trial, and the Harmon County subsurface drip irrigated RACE trial (October 2). These demonstrations focused on tankmixing various defoliants with ethephon, and consisted of 8 treatments (Table 2). Signs were installed on each treatment at both sites so producers could observe and determine the most effective treatment. The treatments applied are listed in the table below. Plots were 4 rows wide and 150 feet long. All treatments were applied with a high-clearance compressed air, research sprayer at 15 GPA with Turbo Teejet nozzles on 20 inch spacings. Since these plots were not replicated no data was collected (strictly for demonstration purposes only).

Treatment number	Treatment (rates are per acre) (Ethephon was 6 lb/gallon formulation)
1	32 oz ethephon + 16 oz Folex
2	32 oz ethephon + 2.5 oz ET + 1% COC
3	32 oz ethephon + 1 oz Sharpen + 1% MSO + ammonium sulfate
4	32 oz ethephon + 0.8 oz Display + 1% COC
5	32 oz ethephon + 6.4 oz Ginstar
6	21 oz ethephon + 8 oz Ginstar
7	24 oz ethephon + 12 oz Finish 6 Pro + 6.4 oz Ginstar
8	24 oz ethephon + 12 oz Finish 6 Pro + 16 oz Folex

Table 2. Treatments used in 2013 harvest aid demonstrations.

Beltwide Cotton Conference Presentations

Project personnel were involved in several Beltwide Cotton Conference presentations in New Orleans, LA in January 2014.

Horseweed continues to be a troublesome weed for many producers in Oklahoma. One project presented focused on the effectiveness of sulfonylurea herbicides with and without 2,4-D.

Defoliation is an important part of every grower's management program. A project was presented that focused on the use of three new harvest aid products, ETX, Sharpen and Display, for defoliation.

Topguard (flutriafol) is a triazole fungicide that has been recently granted a Section 18 registration in Texas for the management of cotton root rot. This project was established in a known cotton root rot field and focused on rates, application methodology, and flutriafol formulations.

Working in collaboration with several Extension and researcher personnel across the Cotton Belt, Dr. Randy Taylor led a project investigating the utility of using picker harvesters with yield monitors for determining yield in on-farm cotton variety trials.

The use of yield monitor technology has enabled growers to identify yield variation within a production unit. Natural variability in the field and the condition of cotton at harvest make it difficult to calibrate yield monitors for stripper harvesters. A project was conducted which focused on quantifying the spatial variability of gin turnout within a particular cotton field.

Recent inquiries regarding the effects of commercial stripper harvester designs on fiber quality generated a project recently presented at the Beltwide Cotton Conference.   This project evaluated the effects of a wire belt conveyor as a cross auger replacement on several characteristics.

Preplant Control of Horseweed for No-Till Cotton in Oklahoma

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Abstract

Horseweed continues to be a challenge to control in many no-till cotton fields in Oklahoma due to its competitive nature. Controlling horseweed prior to planting cotton is essential since in-season chemical options are very few and often completely ineffective due to glyphosate resistance. The objectives of this project were to evaluate the effectiveness of FirstShot, Panoflex and Amathon applied alone or in a tank-mix with 2,4-D and glyphosate, and to compare the performance of these products to a standard hormone-based horseweed control program. Broadcast over-the-top applications were made with a compressed air, high-clearance sprayer with a spray volume of 10 gallons per acre (GPA). Four replicates of fifteen treatments were used, including an untreated control. Each of these herbicides were applied alone, in combination with 2,4-D and in combination with both 2,4-D and glyphosate. The 0.6 oz/A rate of FirstShot applied alone did not effectively control horseweed, but control did approach acceptable levels (78%) when the rate was increased to 0.8 oz/A. Regardless of rate, Panoflex applied alone at 0.45 oz/A provided similar control to the higher rate of FirstShot. Amathon was the only product applied alone that provided acceptable control of horseweed (88%). The addition of 2,4-D to any of the sulfonylurea (SU) treatments resulted in excellent control of horseweed. Although no benefit was observed from the addition of glyphosate to any SU/2,4-D combination, 2,4-D + glyphosate did effectively control (100%) horseweed and results suggest that glyphosate resistant horseweed was not present at this site.

Introduction

Horseweed continues to be a challenge to control in many no-till cotton fields in Oklahoma. Due to its competitive nature, a failure to control horseweed prior to planting results in reduced stands, harvest complications and reduced lint yields. Controlling horseweed prior to planting cotton is essential since in-season chemical options are very few and often completely ineffective due to glyphosate resistance. Hormone type herbicides have traditionally been the basis for preplant control programs in cotton, however many producers would prefer not to use them. Once in the sprayer system, it is virtually impossible to completely clean out 2,4-D. In addition, hormone based programs come with lengthy plant-back intervals. Currently, Oklahoma growers are advised to wait 30 days following an application of 2,4-D before planting cotton. Controlling horseweed without hormone-type herbicides would have the benefits of shortening the required plant-back interval and eliminating potential sprayer contamination issues. Sulfonylurea (SU) herbicides offer a different site-of-action compared to glyphosate and have proven to be effective on many additional broadleaf weed species. In addition, some offer shorter plant-back intervals compared to hormone herbicides. This project focused on the use of three SU herbicides: Firstshot, Panoflex and Amathon. FirstShot and Panoflex are currently registered for use ahead of cotton planting and only require 14-21 days (depending on soil type and pH) after application before planting cotton. Amathon's registration is currently pending.

Materials and Methods

This study was established as a randomized complete block design with four replicates and was conducted on a clay loam soil in Tillman County. Broadcast over-the-top applications were made with a compressed air, high-clearance sprayer with a spray volume of 10 gallons per acre (GPA). Treatments were applied on March 13, 2013 utilizing FirstShot, Panoflex and Amathon. A total of fifteen treatments were used, including an untreated control, and are listed in figure 1. Each of these herbicides were applied alone, in combination with 2,4-D (Barrage HF) and in combination with both 2,4-D and glyphosate (Roundup PowerMax). These treatments were compared to 2,4-D + glyphosate. Although our standard 2,4-D rate for horseweed control is 1.0 lb ai/a, in order to more clearly quantify the benefits of the SU herbicides the rate of 2,4-D used was 0.6 lb ai/A. The horseweed ranged from 2 to 5 inch rosettes at the time of application. Treatments were applied at 28 psi with flat fan nozzles. Figure 3 provides the observed treatment performance at 14, 28 and 45 days after treatment (DAT).

Untreated
0.6 oz/A FirstShot SG
0.6 oz/A FirstShot SG+ 0.6 lb ai/A 2,4-D
0.6 oz/A FirstShot SG + 0.6 lb ai/A 2,4-D + 1.0 lb ai/A glyphosate
0.8 oz/A FirstShot SG
0.45 oz.A Panoflex
0.45 oz/A Panoflex + 0.6 lb ai/A 2,4-D
0.45 oz/A Panoflex + 0.6 lb ai/A 2,4-D + 1.0 lb ai/A glyphosate
0.6 oz/A Panoflex
0.6 oz/A Panoflex + 0.6 lb ai/A 2,4-D
0.6 oz/A Panoflex + 0.6 lb ai/A 2,4-D + 1.0 lb ai/A glyphosate
0.33 oz/A Amathon
0.33 oz/A Amathon + 0.6 lb ai/A 2,4-D
0.33 oz/A Amathon + 0.6 lb ai/A 2,4-D + 1.0 lb ai/A glyphosate
0.6 lb ai/A 2,4-D + 1.0 lb ai/A glyphosate
All treatments included 0.25% v/v non-ionic surfactant + 2 lb/A Ammonium Sulfate

Figure 1. Horseweed treatments evaluated

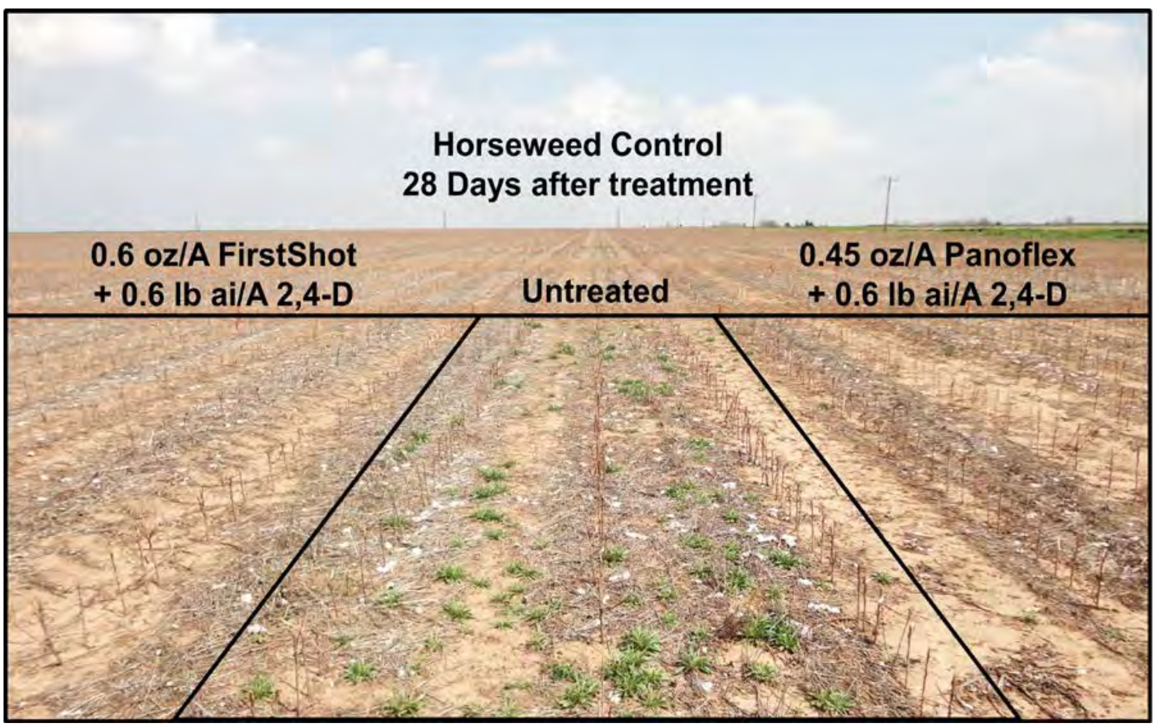

Figure 2. Horseweed control with FirstShot and Panoflex.

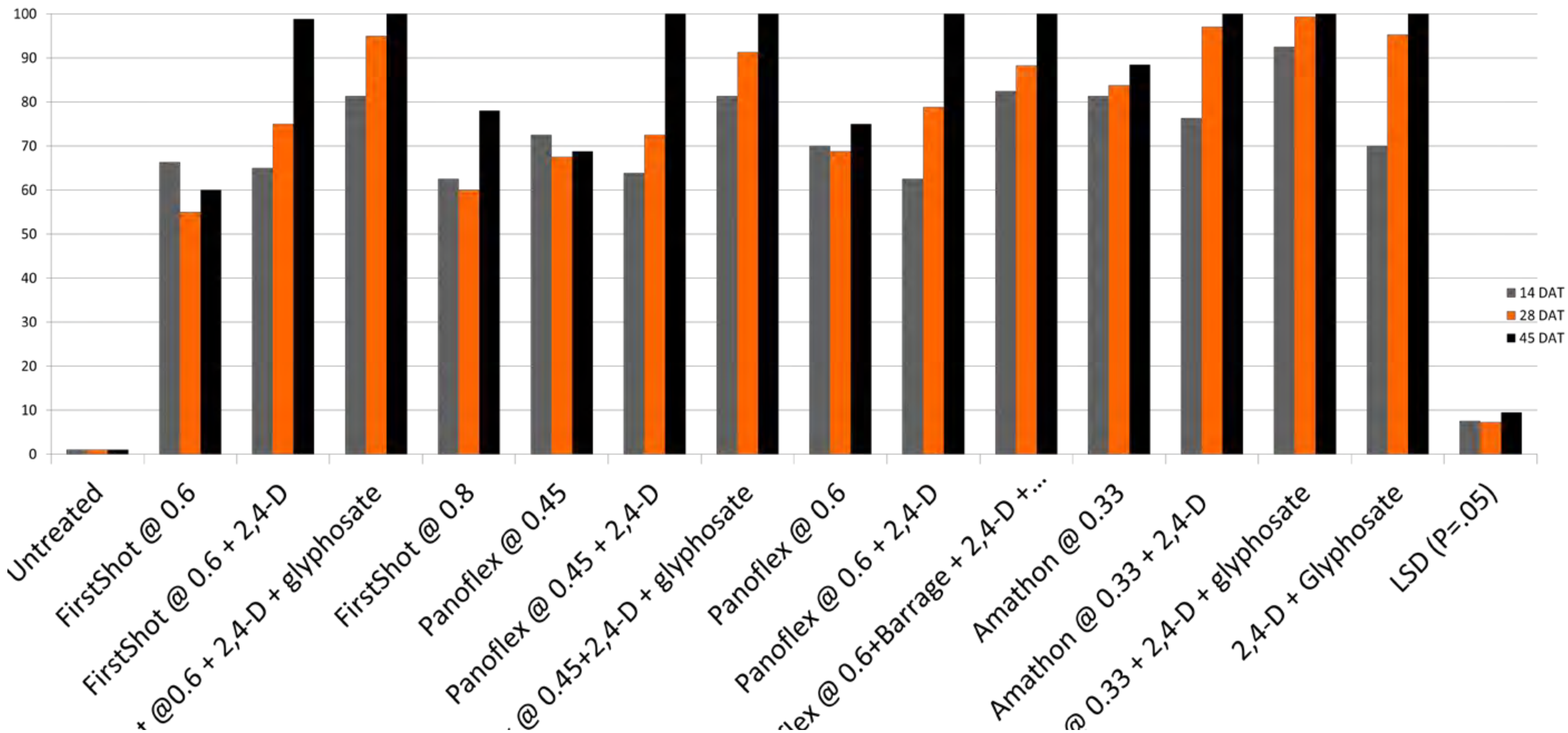

Figure 3. Horseweed Control at 14, 28 and 45 DAT

Results and Discussion

FirstShot applied alone at 0.6 oz/A controlled horseweed 55-65% over the course of all three evaluations (14, 28 and 45 DAT). Increasing the rate of FirstShot to 0.8 oz/A did not significantly increase horseweed control at 14 or 28 DAT. However, by the 45 day evaluation this treatment provided 78% horseweed control, which was significantly greater than the control provided by the lower rate. When 0.6 oz/A of FirstShot was combined with 2,4-D, horseweed was controlled 98% at 45 DAT. Similar control was observed when glyphosate was added to the tank-mix of FirstShot + 2,4-D. Panoflex, regardless of rate (0.45 or 0.6 oz/A) controlled horseweed 69-75% 45 DAT. The addition of 2,4-D increased horseweed control to 100%. Similar control was observed when glyphosate was added to the tank-mix of Panoflex + 2,4-D. Amathon applied alone at 0.33 oz/A controlled horseweed 88% 45 DAT. The addition of 2,4-D increased horseweed control to 100 %. Similar control was observed when glyphosate was combined with tank-mixes of Amathon + 2,4-D. 2,4-D + glyphosate controlled horseweed 100% 45 DAT.

Summary and Conclusions

The lower rate of FirstShot applied alone did not effectively control horseweed. However, control did approach acceptable levels (>80%) when the rate was increased. Regardless of rate, Panoflex applied alone provided similar control to the higher rate of FirstShot. Amathon was the only product applied alone that provided acceptable control of horseweed (88%). The addition of 2,4-D to any of the SU herbicide treatments resulted in excellent control of horseweed. Although no benefit was observed from the addition of glyphosate to any SU/2,4-D combination, 2,4-D + glyphosate did effectively control (100%) horseweed at this location. This does allow for speculation concerning potential control provided by combinations of glyphosate with only the SU products (without 2,4-D). However, the documented presence of glyphosate resistant horseweed in Oklahoma and the incomplete control observed from FirstShot, Panoflex and Amathon applied alone, removes the consideration of programs depending heavily upon glyphosate. It should be noted that the performance of 2,4-D + glyphosate within this study suggests that no glyphosate resistant horseweed was present at this location.

Acknowledgements

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PERFORMANCE OF ETX, DISPLAY AND SHARPEN AS HARVEST AIDS IN OKLAHOMA COTTON

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Abstract

ETX is a new formulation of pyraflufen ethyl with lower use rates offered from Nichino America, Inc. ETX is currently registered for use as both a herbicide for weed control and as a cotton harvest aid. The objectives of this project were to evaluate the effectiveness of ETX as a harvest aid and to compare the performance of ETX to other recently registered harvest aid products including Display and Sharpen. Four replicates of 6 treatments were used including an untreated control. ETX was applied at 1.25 and 1.7 oz/A, Display was applied at 0.6 and 0.8 oz/A, and Sharpen was applied at 1.0 oz/A. All treatments were tank mixed with 32 oz/A of ethephon (6 lb/gallon product) and applied to cotton at 12 gallons/acre (GPA) that exhibited approximately 55-60% open bolls. Although Sharpen provided the greatest amount of defoliation observed at 14 DAT there was very little difference between its performance and the remaining treatments. The defoliation observed from Display did improve as the rate increased and ETX provided similar defoliation regardless of rate. This could be attributed to the extremely favorable weather following application. Results indicate that all products evaluated offer effective harvest aid options to Oklahoma cotton producers.

Introduction

ETX is a new formulation of pyraflufen ethyl with lower use rates offered from Nichino America, Inc. Currently ETX is registered for use as both a herbicide for weed control and as a cotton harvest aid for defoliation and desiccation. While many cotton producers may be familiar with the original formulation of pyraflufen ethyl (ET), they have no experience with this new formulation. The new more concentrated formulation allows for a rate structure equivalent to approximately 60% of the previous formulation's rates. In addition, Sharpen and Display are similar chemistries (PPO inhibitors-group 14) that have been recently registered for use as cotton harvest aids. All three of these products offer growers a unique benefit in addition to their performance as harvest aids. Often times when harvest aids are applied to Oklahoma cotton, adjacent fields of small grains are already emerged. Unlike paraquat (a popular cotton harvest aid) these products are relatively safe when used in proximity to adjacent small grain fields. Due to extensive acreage of small grains in Oklahoma these products have a unique fit for cotton producers. This project was established to evaluate the performance of ETX as a harvest aid in comparison with Display and Sharpen. The objectives of this project were to evaluate the effectiveness of ETX as a harvest aid and to compare the performance of ETX to other recently registered harvest aid products including Display and Sharpen.

Materials and Methods

A randomized complete block design with four replicates was used. The trial was conducted on a clay loam soil. Treatment applications were made with a compressed air, high-clearance sprayer. A spray volume of 12 GPA was applied with Turboteejet nozzles at 60 PSI on September 26, 2013. Cotton was approximately 55-60% open. The site was furrow irrigated, had a yield potential of 2.5-3 bales/acre, and had a moderate canopy at application. ETX was applied at 1.25 and 1.7 oz/A, and each was in combination with 32 oz/A of ethephon (6 lb/gallon product). Similarly, Display was applied at either 0.6 or 0.8 oz/A with 32 oz/A of ethephon. Sharpen was applied at 1.0 oz/A also in combination with 32 oz/A of ethephon. All treatments except Sharpen included crop oil concentrate at ½ % v/v. Sharpen included methylated seed oil at 1% v/v plus ammonium sulfate (17 lbs/100 gallons). Defoliation and open boll visual evaluations were taken 7 and 14 days after treatment. Terminal and basal regrowth were also visually evaluated 21 days after treatment. The data were subjected to analysis of variance and results are presented in figures 1 and 2.

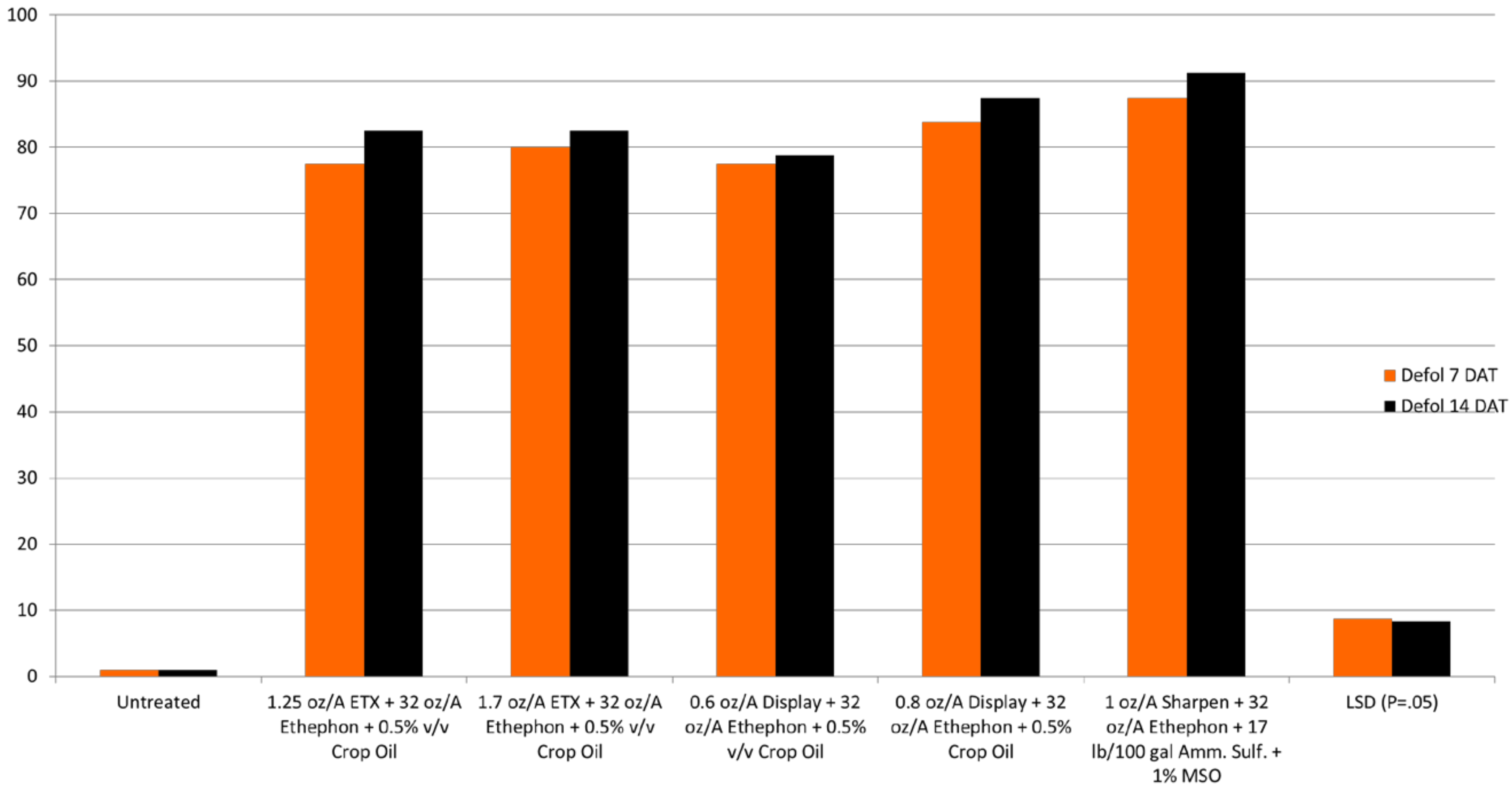

Figure 1. Defoliation 7 and 14 DAT.

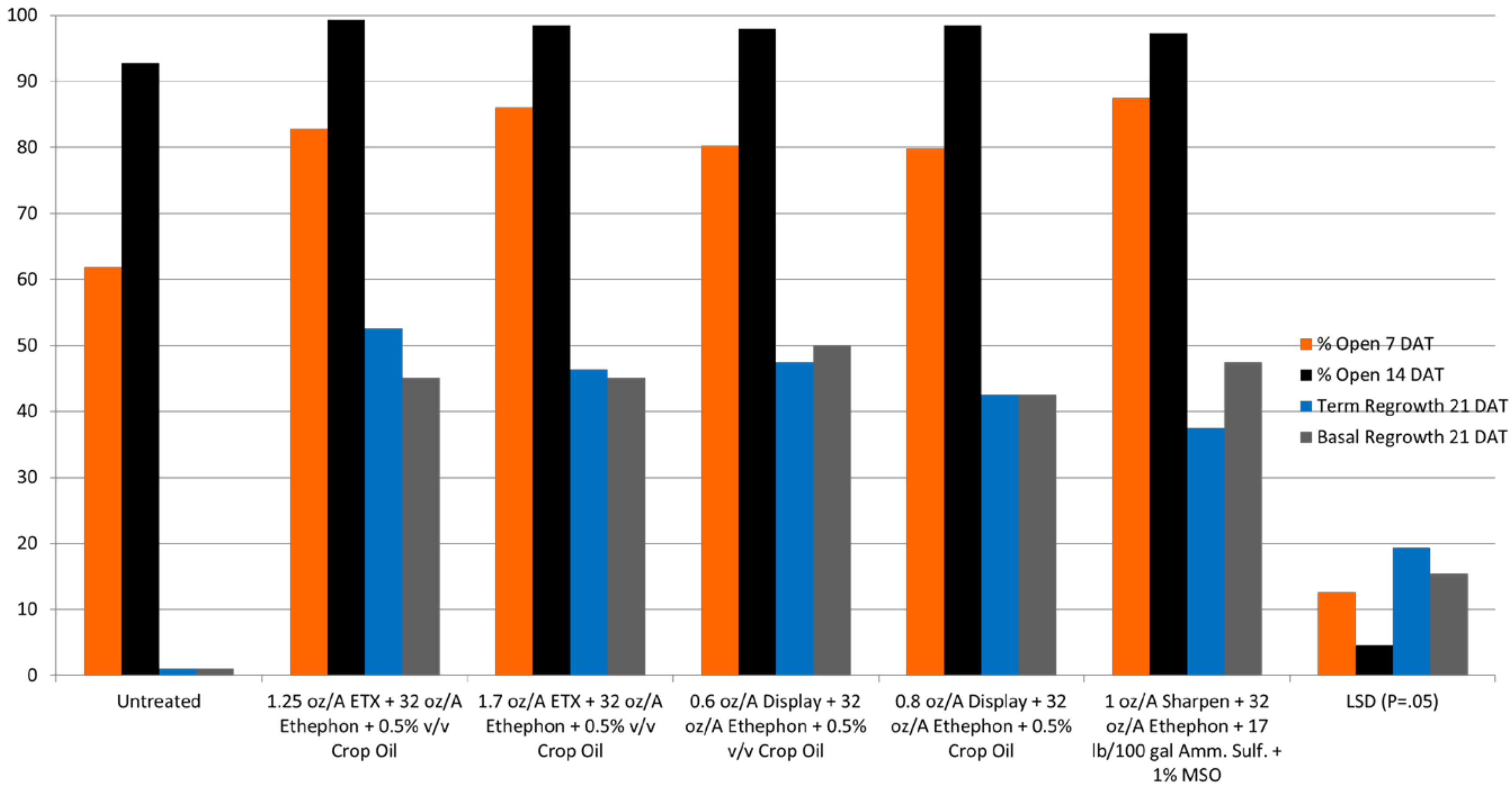

Figure 2. Open boll percentages (7 and 14 DAT) and regrowth (21 DAT).

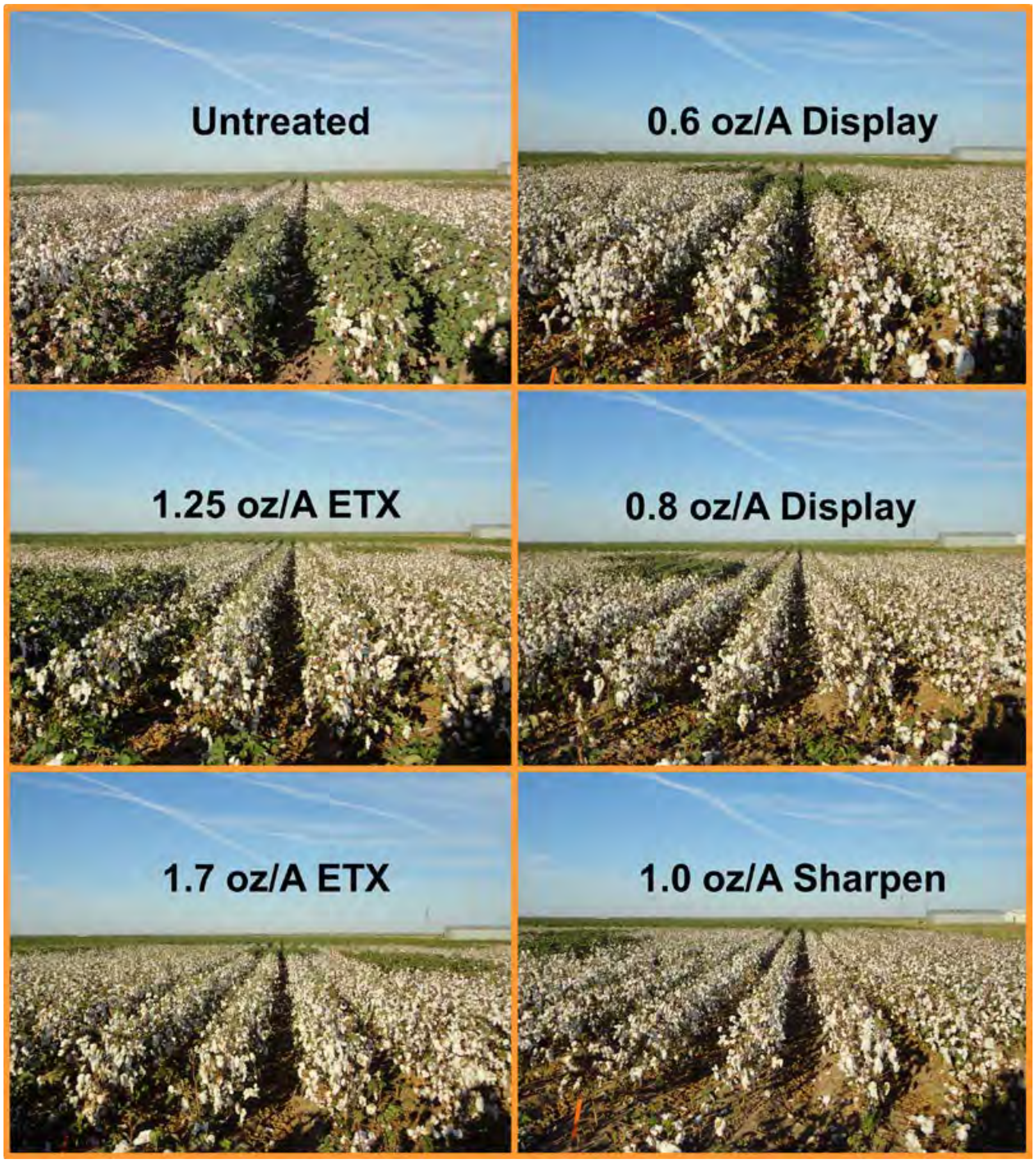

Figure 3. Treatment performance 14 days after application.

Results and Discussion

Defoliation provided by each treatment is presented in figure 1. Seven days after treatment (DAT) the low rate of ETX (1.25 oz/A) provided 78% defoliation. The higher rate of ETX did not significantly increase defoliation (80%) 7 DAT. Similar defoliation (78-84%) was provided by Display. Sharpen provided 88% defoliation 7 DAT. This was significantly greater than the low rates of ETX and Display but similar to higher rates of these products. All treatments provided similar boll opening (80-88%) at 7 DAT, and were significantly higher than the untreated control. ETX (regardless of rate) provided 83% defoliation 14 DAT. Similar defoliation was observed from 0.6 oz/A of Display. The higher rate of Display (0.8 oz/A) defoliated cotton 88% 14 DAT. This was significantly greater than the lower rate. Sharpen provided similar defoliation (91%) 14 DAT. All treatments resulted in > 97%

boll opening 14 DAT. Regrowth evaluations were made 21 DAT. Terminal and Basal evaluations were recorded separately. Terminal regrowth was very inconsistent across replicates. Although numerical evaluations ranged from 38 to 53%, there were no significant differences among treatments. Basal regrowth observations were less variable (ranging from 43-50%), but there were no significant differences among treatments.

Summary and Conclusions

The performance of harvest aids products depends heavily upon two factors. One is the condition of the cotton at application time and the other is the weather experienced following application. As stated earlier this cotton was irrigated throughout the growing season and was not stressed at the time of application. It had a moderate crop canopy, was experiencing natural senescence prior to application, and was 55-60% open. Temperatures following application were extremely favorable and in the seven day period following application, 155 degree days (60 degree base threshold) or DD60 heat units were recorded at the site. Average DD60 accumulation during this period is approximately 91. Heat unit accumulation for all 14 days following application totaled 207 (an additional 52 from days 8-14). This is a 51% increase compared to the longterm average (137). In addition, approximately one inch of rainfall was received during the 14 days following application. Although Sharpen provided the greatest amount of defoliation observed (91%) 14 DAT there was very little difference between its performance and the remaining treatments (< 9%). The defoliation observed from Display did improve as the rate increased. ETX provided similar defoliation (83%) regardless of rate. This could be attributed to the extremely favorable weather following application. All three of these products offer effective harvest aid options to Oklahoma cotton producers. All of the treatments evaluated were considered effective enough to enable an efficient picker harvest without a sequential treatment. However, all treatments would have required a sequential desiccant application in order to enable an efficient stripper harvest.

Acknowledgements

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FIELD EVALUATION OF TOPGUARD (FLUTRIAFOL) FOR COTTON ROOT ROT MANAGEMENT IN OKLAHOMA

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Abstract

Phymatotrichopsis or cotton root rot (PRR) is caused by the fungus *Phymatotrichopsis omnivora*. Flutriafol (brand name Topguard) fungicide has recently been evaluated as a chemical management option. The objectives of this project were to evaluate the effects of two flutriafol rates (0.13 and 0.26 lb active ingredient/acre), two product formulations (Topguard and CHA-1328), and two application methods (T-band and modified in-furrow). An untreated check was included. In 2013 replicated trials were established in two known PRR infested producer-cooperator fields. Locations included a Tillman County no-till dryland site, and a Kiowa County furrow irrigated conventional tillage site. No substantial stand reduction issues arising from flutriafol treatments were noted at the Tillman County dryland site, but T-band treatment resulted in slightly higher stand counts at 14 and 28 days after planting (DAP) when compared to the modified in-furrow method. The dryland site expressed minimal disease incidence and later failed due to drought. The modified in-furrow application method reduced stand establishment at the Kiowa County site at 14 and 28 DAP, and resulted in a small but significant reduction in plants/row-ft when compared to the T-band. Although spatially variable, PRR infection at the Kiowa County site was very pronounced by Sep 26. By that date, about 66% of the plants in the untreated control were diseased. The 0.13 and 0.26 lb/acre flutriafol rates exhibited about 36% and 19% diseased plants, respectively. No differences were noted with respect to product or application method for diseased plants. Lint yield was significantly improved by flutriafol application. The 0.26 lb/acre rate resulted in significantly higher yield than the 0.13 lb/acre rate and the Topguard product resulted in greater yield than CHA-1328. Application method had no effect on lint yield. These data indicate that flutriafol is an effective product to reduce PRR induced stand and yield losses in Oklahoma.

Introduction

Phymatotrichopsis or cotton root rot (PRR) is caused by the fungus *Phymatotrichopsis omnivora*. Once infected, cotton is rapidly killed by this disease. As a result, yield is severely reduced, and harvesting efficiency declines due to dead stalks becoming entangled in harvester row units, particularly with stripper-type machines. Flutriafol (brand name Topguard) fungicide has been recently evaluated in Texas as a chemical control option. Isakeit et al. 2011, 2012 and 2013) show the progression from identification of flutriafol as a means of control through refinement of application techniques and rates. This work culminated in the 2012 and 2013 Texas Section 18 approvals by EPA (Drake et al., 2013). Oklahoma has several counties which border the Red River where many fields with the disease can be found (Damicone, 2010). Once recognized, growers generally choose to continuously plant infested fields to other unaffected monocot crops. Unfortunately there are very few economically viable rotational options. Planting cotton is an effective crop rotation, particularly for wheat, as it breaks weed and disease cycles that can be problematic for the grain crop. The availability of flutriafol as an efficacious PRR control product would enable Oklahoma producers to diversify crop rotations and allow cotton planting in PRR infested fields. The objectives of this project were to evaluate the effects of two flutriafol rates and product formulations, and two application methods for PRR control in Oklahoma cotton.

Materials and Methods

In 2013, two trials were established in known PRR infested producer-cooperator fields in southwestern Oklahoma to investigate the use of flutriafol for PRR control. Treatments included an untreated control, two flutriafol product formulations with different active ingredient (a.i.) formulations (Topguard with 1.04 lb a.i./gallon and CHA-1328 with 4.17 lb a.i./gallon), two rates - 0.13 and 0.26 lb a.i./acre, and two methods of application (T-band and modified in-furrow). These methods have been previously described in detail by Isakeit et al. (2013). A Schaffert rebounder was used with the modified in-furrow placement, and pressure was 17 psi. T-Band placement was accomplished using a Teejet 8002 flat fan even flow nozzle set to 24 psi. Total volume was 4 gallons/acre using a CO_2 system.

Four replicates of the 9 treatments were included at the Tillman County no-till dryland site, while the Kiowa County furrow irrigated conventional tillage site had 3 replicates. Plot size was four 40-inch rows by 50 ft long. A John Deere MaxEmerge XP vacuum planter was used. The Kiowa County site was planted with 4 seed/row-ft on May 24. Extreme environmental conditions resulted in difficult stand establishment. The Tillman County site was planted on June 13 at a higher than normal 5 seed/row-ft due to extreme environmental conditions. PhytoGen 499WRF cultivar was planted at both sites. Observations were made on the center two rows by the length of each plot, including lint yield. Plot harvest was accomplished using a modified John Deere 482 plot stripper. Analysis of variance was performed on the data using SAS Ver. 9.3 for Windows.

Results and Discussion

Results are presented in Table 1. Rainfall events of 0.4 and 0.8 inches were encountered 5 and 4 days after planting (DAP) at the Kiowa and Tillman County sites, respectively. No serious stand reduction issues arising from flutriafol treatments were noted at the Tillman County dryland site, but the T-band treatment resulted in slightly higher stand counts at 14 and 28 DAP when compared to the modified in-furrow method. The dryland site uniformly emerged and expressed minimal disease incidence and later failed due to exceptional drought.

Application method reduced stand establishment at the Kiowa County site at both 14 and 28 DAP. Modified in-furrow treatment resulted in a small but significant reduction in plants/row-ft. Although somewhat spatially variable, PRR infection at the Kiowa County furrow irrigated site was very pronounced by Sep 26 (Figure 1).

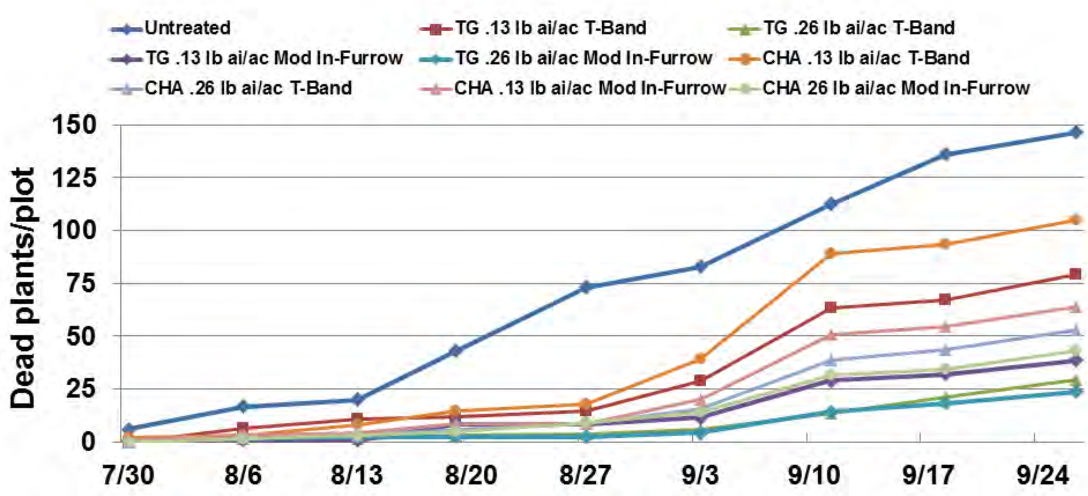

Figure 1. Disease progression at the Kiowa County irrigated site.

By that date, about 66% of the plants in the untreated control were diseased. The 0.13 and 0.26 lb/acre flutriafol rates exhibited about 36% and 19% diseased plants, respectively, with 0.26 lb rate having a lower percentage. No differences were noted with respect to product or application method for diseased plants.

Table 1. Results from dryland (Tillman County) and furrow irrigated (Kiowa County) flutriafol trials.

		Tillman County Dryland		Kiowa County Irrigated			
Trt No.	Description	plants/row-ft 14 DAP	plants/row-ft 28 DAP	plants/row-ft 14 DAP	plants/row-ft 28 DAP	% PRR diseased plants 26-Sep	Lint yield lb/acre
1	Untreated check	4.7	4.7	2.3	2.3	65.7	1226
2	Topguard 0.13 lb ai/ac T-Band	4.7	4.8	2.2	2.3	41.4	1662
3	Topguard 0.26 lb ai/ac T-Band	4.9	4.9	2.2	2.3	13.7	1794
4	Topguard 0.13 lb ai/ac Modified In-Furrow	4.4	4.4	1.7	1.7	22.6	1646
5	Topguard 0.26 lb ai/ac Modified In-Furrow	4.5	4.5	1.8	1.8	14.0	1787
6	CHA-1328 0.13 lb ai/ac T-Band	4.5	4.5	2.1	2.2	48.5	1261
7	CHA-1328 0.26 lb ai/ac T-Band	4.6	4.5	2.3	2.3	24.4	1688
8	CHA-1328 0.13 lb ai/ac Modified In-Furrow	4.5	4.5	2.0	2.1	31.2	1694
9	CHA-1328 0.26 lb ai/ac Modified In-Furrow	4.1	4.1	1.8	1.9	24.6	1592
	Pr > F	0.4786	0.3394	0.0001	0.0269	0.0613	0.0674
	LSD 0.10	NS	NS	0.3	0.3	27.1	335
	CV, %	9.8	8.9	11.5	10.8	59.9	14.7
3-Factor Factorial Analysis							
Rate	0.13 lb ai/ac	4.5	4.6	2.0	2.1	35.9	1566
	0.26 lb ai/ac	4.5	4.5	2.0	2.1	19.2	1715
Product	CHA-1328	4.4	4.4	2.1	2.1	32.2	1559
	Topguard	4.6	4.6	2.0	2.0	22.9	1722
Method	Modified In-Furrow	4.4	4.4	1.8	1.9	23.1	1680
	T-Band	4.7	4.7	2.2	2.3	32.0	1601
Source of variation		Pr > F					
	Rate	0.9406	0.5682	0.8120	0.8688	0.0249	0.0964
	Product	0.2709	0.1304	0.4790	0.5119	0.1875	0.0718
	Method	0.0734	0.0966	0.0027	0.0017	0.2029	0.3647
	Rate*Product	0.4163	0.3315	0.8120	0.7415	0.8369	0.8805
	Rate*Method	0.5049	0.6243	0.4790	0.6216	0.1943	0.1436
	Product*Method	0.6032	0.5147	0.3113	0.1997	0.9589	0.3010
	Rate*Product*Method	0.6032	0.5682	0.2455	0.3298	0.9531	0.1312
	LSD 0.10	0.3	0.3	0.2	0.2	11.8	148
	CV, %	10.4	9.4	12.4	11.7	59.3	12.5

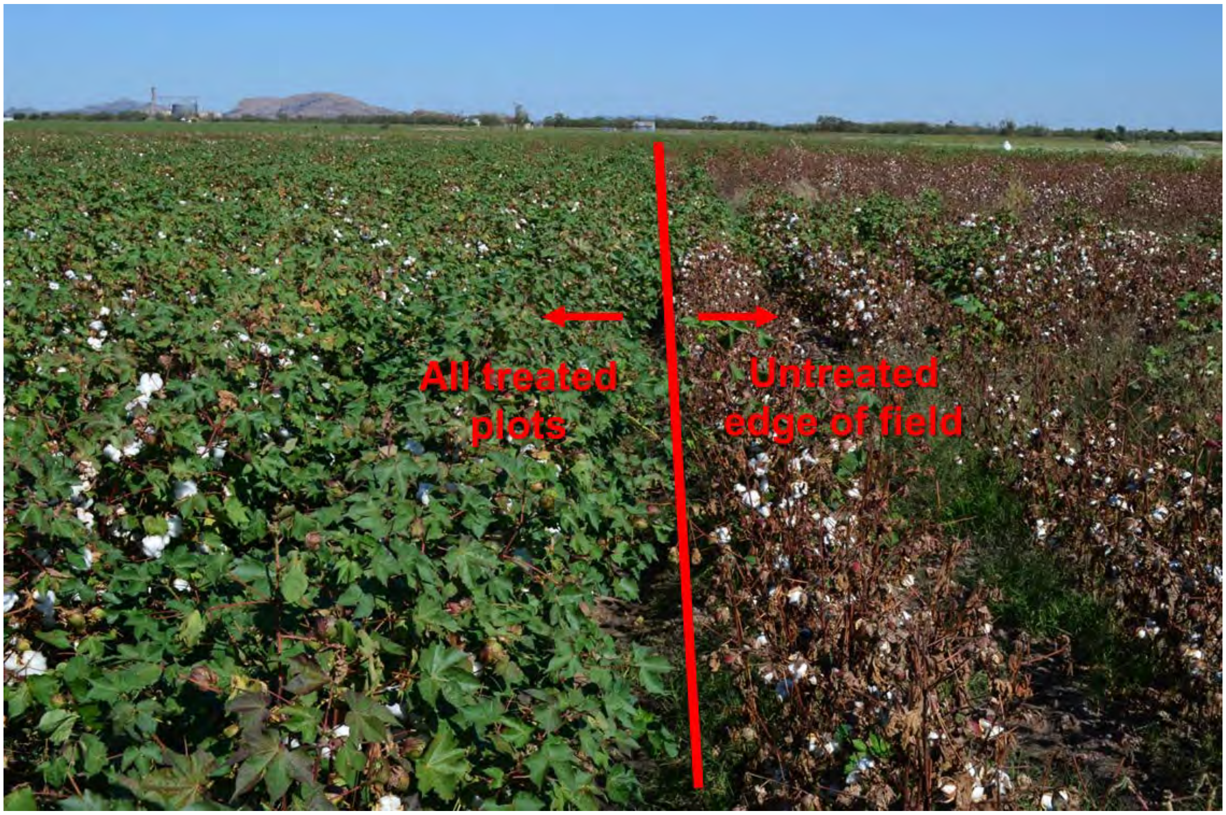

Figure 2. Kiowa County irrigated trial on Oct 1.

Figure 3. Kiowa County irrigated trial at harvest, Nov 1.

Ultimately, lint yield was significantly improved by flutriafol application. The 0.26 lb/acre rate resulted in significantly higher yield than the 0.13 lb/acre rate and the Topguard product resulted in greater yield than CHA-1328. Application method had no effect on lint yield.

Summary and Conclusions

Substantial but spatially variable PRR pressure was encountered at the Kiowa County site. Results indicate that 0.13 and 0.26 lb/acre flutriafol rates had lower percentage diseased plants than the untreated. The 0.26 lb/acre rate resulted in a lower percentage of diseased plants than the 0.13 lb rate. Although no differences were noted with respect to percentage of diseased plants, the Topguard formulation provided greater lint yield than the CHA-1328 product, the reasons for which are unclear. When compared to the modified in-furrow treatment, T-band application method resulted in a higher number of healthy plants at both 14 and 28 DAP, but this did not result in higher yield at harvest. Lint yields were 1226, 1566, and 1715 lb/acre for the untreated check, and flutriafol rate main effect means of 0.13 and 0.26 lb a.i./acre, respectively. When compared to the untreated check, yields were increased by 340 and 489 lb/acre for the 0.13 and the 0.26 lb a.i./acre rates, respectively. This represents 28 and 40 percent yield increases for flutriafol rates of 0.13 and 0.26 lb a.i./acre, respectively, when compared to the untreated check. Results from this project indicate that flutriafol was effective at reducing the negative impact of PRR at this site.

Acknowledgements

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USING YIELD MONITORS TO EVALUATE COTTON VARIETY TESTS

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Abstract

Grain yield monitors have successfully been used to harvest variety and hybrid trials when certain guidelines were followed. However, there has been concern regarding cotton yield monitors and the way that they measure flow rate. A Beltwide effort was initiated to assess yield monitor performance in replicated variety trials with the objective of determining the source of yield monitor errors and developing protocols for using yield monitors to accurately harvest cotton variety trials. Data were collected from at least seven trials across six states. The trials were conducted with field scale plots containing at least six varieties. Yield was measured with the yield monitor and a reference scale. The reference scale varied among locations, but was an accepted device to measure variety yield. Correlation between yield monitor and reference yields for cotton variety tests were generally high for four of six site years. However, the high correlation did not allow yield monitors to effectively group varieties the same as the reference scale. Errors were significant by variety for five of six site-years. No clear methods to adjust for error have been discovered.

Introduction

Robertson et al. (2006) evaluated the potential to use cotton yields monitors for on-farm testing. They considered the correlation between yield monitor and weigh wagon measured yields to determine if varieties were suitable to use in on-farm research plots. A high correlation indicated that the yield monitor reliably measured yield for that variety. They deemed that some varieties were more suited for on-farm research trials than others when a yield monitor would be used to measure yield. Rains et al. (2002) ranked cotton varieties using weigh wagon and yield monitor yields. The mean absolute difference between the two rankings was about 3 with the maximum/minimum difference was +/-9. While they recognized some challenges with the weigh wagons that they used, they believed that variety changes influenced yield monitor accuracy. They speculated that different seed mass among varieties could affect yield monitor weights. Stewart et al. (2008) harvested cotton variety trials to determine the suitability of yield monitors for harvesting on-farm variety trials. They concluded that although yield monitor and weigh wagon data were correlated, the correlation was variety dependent. Thus, yield monitors were not recommended for harvesting on-farm variety trials. The objectives of this research were to determine errors associated with using yield monitors to evaluate cotton variety tests and evaluate pertinent information regarding varieties and harvest conditions that could cause the errors.

Methods

Cotton variety trials were harvested over a two year period (2012 and 2013) in six states. Each trial contained at least six varieties which were replicated three times. The yield monitor manufacturer, mean plot length and mean plot mass as measured by the reference scale are shown in table 1. Yield monitor mass was recorded from the yield monitor display in the cab. It was also checked against the data from the yield monitor file, but the value from the display was used as the yield monitor's measured mass. After the plot was harvested and the value recorded, the seed cotton was unloaded into a boll buggy to measure the actual mass. This is the reference mass that was used to determine error. While the reference scale was different at each location, it was something that would typically be used to measure mass for on-farm research trials. The length and width of all plots were measured. Plots at some locations were uniform in length, however some varied. A sample from each plot was ginned to determine lint turnout. Again, while the ginning procedures, sample size and gin may have varied across locations, the individual procedures were typical for the researchers at each location.

Table 1. Summary data for each site year.

Year	Site	Number of Varieties	Mean Plot length, ft	Mean Mass, lbs	Yield Monitor
2012	Georgia	11	712	570	AgLeader
2012	South Carolina	6	500	1188	AgLeader
2012	Texas	8	536	321	John Deere
2013	Georgia	12	1442	986	AgLeader
2013	Oklahoma	10	590	2069	Trimble
2013	Texas	8	1427	1598	John Deere

Error was calculated for each plot on a mass basis. However, all variety comparisons were made based on seed cotton yield. Comparing varieties based on yield accounts for the non-uniform plot length at some locations.

Results

Mean seed cotton yield as determined by the reference scale and yield monitor are shown in table 2 by site-year. Mean yields ranged from 1977 to over 6000 lbs/ac. It should be noted that the 2013 Oklahoma site was stripper harvested, thus it had a greater seed cotton yield (in a very good crop year) and lower lint turnout. Correlation between yield measure by the two methods (reference and yield monitor) exceeded 0.90 for four of the six site-years. There was no correlation for the Oklahoma site in 2013 and a negative correlation for Texas in 2013 (figure 1). The high correlations were in line with those reported by Robertson et al (2006) and Stewart et al. (2008).

Analysis of variance was used to determine varietal yield differences each site. This was done with yield calculated from both the reference scale and yield monitor. Significant yield differences among varieties were detected for all site-years. Yield monitors tended to group the varieties similar to the reference scale for the site years with the highest correlation coefficients. However there were differences that could potentially affect variety decisions. In general, the highest and lowest yielding varieties were placed in the same statistical groups by the yield monitor and reference scale. Varieties that yielded near the mean for a location were typically not grouped similarly by the two means for measuring yield. As expected the statistical groupings of varieties for the two site-years with low correlation coefficients were not similar using the two methods to determine yield.

Errors were significantly different by variety for five of the six site-years. This demonstrates that certain varieties are responding similarly when measured by the yield monitor. However, no clear methods to adjust for error have been discovered at this time. Yield monitor error for some site-years was related to lint turnout data, but this relationship was inconsistent across site-years (figure 2). While other data (boll mass, seed mass, etc.) were collected as part of this research that data has not been fully analyzed.

Table 2. Mean yields, errors and correlation between reference and yield monitor yields.

Year	Site	Mean Reference Seed Cotton Yield, lbs/ac	Mean YM Seed Cotton Yield, lbs/ac	Mean Error, %	Mean Lint Turnout, %	Correlation Coefficient
2012	Georgia	2909	2741	-5.5	41.8	0.91
2012	South Carolina	4085	3967	-2.6	42.2	0.92
2012	Texas	1977	1208	-40.8	36.7	0.91
2013	Georgia	2637	2725	3.4	39.4	0.90
2013	Oklahoma	6364	6583	4.7	26.8	0.04
2013	Texas	3668	2758	-24.5	37.5	-0.20

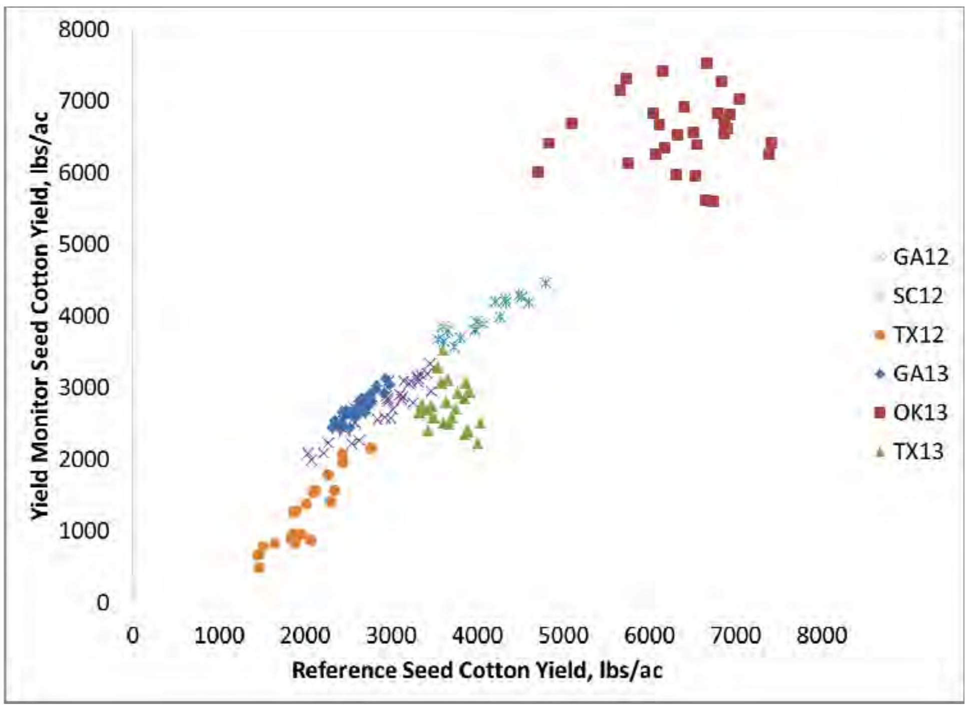

Figure 1. Relationship of seed cotton yield using two measurement methods for six site-years.

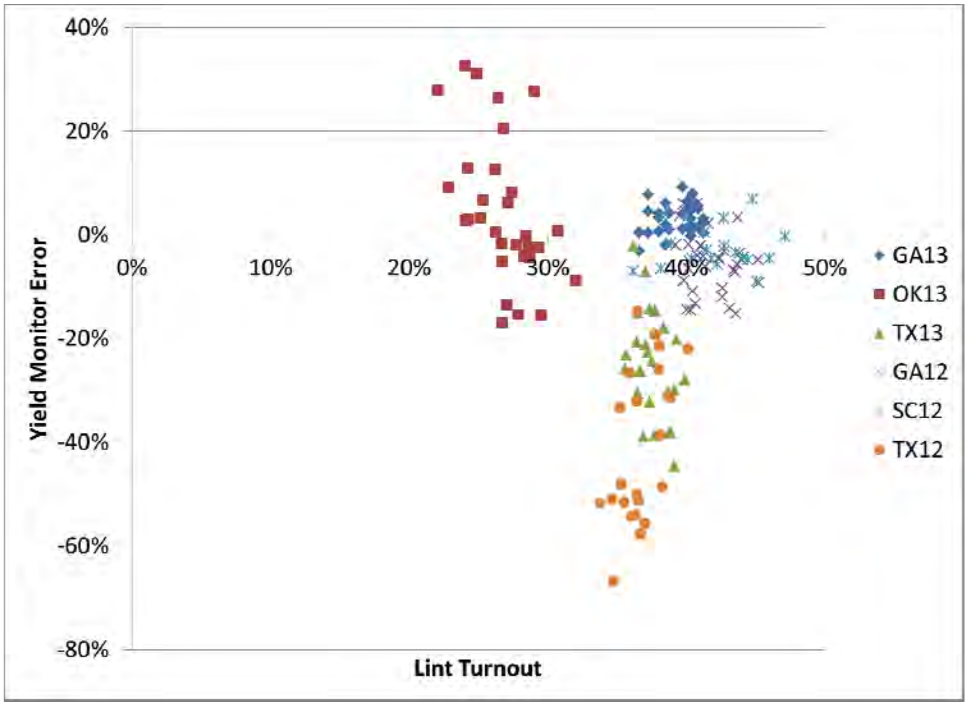

Figure 2. Relationship yield monitor error to lint turnout.

Summary

Correlation between yield monitor and reference yields for cotton variety tests were generally high for four of six site years. However, the high correlation did not allow yield monitors to effectively group varieties the same as the reference scale. Errors were significant by variety for five of six site-years. No clear methods to adjust for error have been discovered.

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SPATIAL TURNOUT ON STRIPPER HARVESTED COTTON

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Abstract

The main goal of this study was to document the spatial turnout of stripper harvested cotton across a production cotton field. The data provided an insight to aid in the determination of the variability of lint turnout from stripper harvested cotton and its potential effects on predicting yield. A production field near Canute, OK was selected and cotton was harvested from this field using a 6-row cotton stripper. Three 1100 ft long transects were harvested from the production field. Weight samples for yield determination were collected every 100 ft. An approximate 25-lb sub-sample was collected from each of the yield samples. Lint turnout was collected from each of the 33 samples. There were no significant correlations with lint turnout and yield. Lint turnout was not variable and ranged from 30% in lower yielding cotton to 37% in higher yielding cotton. A correlation was found between lint turnout and both lint yield and seed cotton yield for the lower yield transect. In higher yielding cotton it does not appear that lint turnout is correlated to either seed cotton or lint yield. However, since there is a correlation present between seed cotton yield, lint yield, and lint turnout in lower yielding cotton then more spatial turnout work should be performed on lower yielding cotton stands to determine the sources of the correlation.

Introduction

Unlike picker harvesters, which use spindles to remove seed cotton from open bolls, stripper harvesters use brushes and bats to indiscriminately remove seed cotton, bolls, leaves, and other plant parts from the stem of the plant (Porter 2013). Stripper harvested bur cotton contained 27.8% total trash compared to 4.6% for spindle picked seed cotton (Kerby et al., 1986; Baker et al., 1994; Faulkner et al. 2011a). Garner et al. (1970) reported that spindle picked cotton ginned an average of 24% faster than stripped cotton due to much lower content of foreign matter. The harvesting efficiency or the amount of crop material removed during harvest with a picker is lower than that with a stripper harvester. Field losses are lower than those from pickers and under ideal harvesting conditions; a stripper can harvest 99% of the cotton on the plant compared to 95-98% with a picker and in some instances the picker will have harvest losses approaching 20% (Hughs et al. 2008).

Stripper harvesting is predominately confined to the Southern Plains of the US due to several factors including: low humidity levels during daily harvest intervals, tight boll conformations and compact plant structures adapted to withstand harsh weather during the harvest season, and reduced yield potential due to limited rainfall and irrigation capacity. Cotton strippers typically cost about one-third the price of cotton pickers and have harvesting efficiencies in the range of 95 – 99% making them ideal for lower yielding cotton conditions (Faulkner et al. 20011b and Williford et al. 1994). In 2010, approximately 50% of the total number of cotton bales produced in the U.S. came from Texas and Oklahoma (USDA, 2011). Approximately 70-75% of the cotton harvested in these two states was harvested with stripper harvesters. Over one quarter of the cotton harvested in the U.S. in 2010 was harvested with cotton strippers (USDA, 2011).

Thus, stripper harvesting is not going to disappear from the Southern High Plains and is a viable and cheaper alternative option to picker harvesters. However, the higher trash levels can present specific challenges during both harvest, transport, and ginning. The foreign matter levels can be variable and can lead producers to getting variable lint turnout numbers from the gin from the modules that they deliver. The variability in lint turnout at the gin can make it very difficult to accurately estimate lint yield. If the variability truly exists, as producers believe it does then this study can aid in determining correlations to the variability.

The main objective of this study was to document the spatial turnout of stripper harvested cotton across a production cotton field. The secondary objective was to determine the variability of lint turnout of the harvested cotton and its potential effects on predicting yield.

Materials and Methods

Cotton was harvested on December 3, 2013 near Canute, OK to determine spatial yield and turnout variability. The cotton variety, Delta Pine 0935, was grown in a dryland environment on 40 inch wide rows. Three transects, approximately 1100 feet in length, were segmented into 100 feet increments except the last segment where the length final length was slightly shorter due to field shape. The harvested transects were parallel and approximately 200 feet apart (Figure 1). A 6-row John Deere 7460 cotton stripper was used to harvest the crop.

Each transect sample area was 6 rows wide by 100 feet long.										
Transect 1										
A	B	C	D	E	F	G	H	I	J	K
Transect 2										
A	B	C	D	E	F	G	H	I	J	K
Transect 3										
A	B	C	D	E	F	G	H	I	J	K

Figure 1. Field map of transects and sampling areas, not to scale.

The stripper harvested each segment and unloaded into a boll buggy where the bur cotton was caught in a 10 by 12 plastic tarp. The tarp containing the cotton was weighed by suspending it from four 50 lb load cells (Interface …) (Figure 2). The load cells weigh connected to a summing junction (Interface Advanced Force Measurement Model # JB104SS Scottsdale, AZ) and the resulting value was displayed on a digital readout (Interface Display and Signal Conditioner Model #: 9820-000-1 Serial #: M3511). The display also supplied power to the load cells. After a weight was recorded, approximately 25 lbs was bagged for ginning.

Figure 2. The sample collection system, located inside of the boll buggy.

Each of the harvesting samples was processed through an extractor-feeder (Continental Gin Company-Moss Gordin, Birmingham, AL, Type C-95, Serial No.: 8866 (BM: 948428), top saw 0.36 m diameter @ 374 rpm, middle saw 0.36 m diameter @ 374 rpm, bottom saw 0.36 m diameter @ 77 rpm), 16-saw gin stand (Continental Gin Company, Birmingham, AL, Model: 610, Type: 16B79, Saw Cylinder 0.41 m diameter @ 720 rpm originally 21 saw original width reduced to 16 saws, and doffer brush speed 1830 rpm), and one stage of saw-type lint cleaning (Continental Gin Company Birmingham, AL, Model: 620, Type: G120B, upper roller speed 86 rpm, feed roller speed 91.5 rpm, main saw 0.41 m diameter @ 882 rpm, doffer brush speed 1472 rpm). After ginning all the cleaned lint from a harvesting sample was weighed on an Electroscale (Model LC2424, capacity: 99.8 kg, Display: Electroscale Weigh Master 551, capacity: 90.7 kg, resolution 0.005 kg) to obtain lint turnout. Lint turnout was calculated by dividing the clean lint weight by the total sample weight and multiplying by 100. The trash collected from the extractor-feeder and seeds from the gin stand were collected and weighed on the same Electroscale. The seed and trash weights were used to aid in ensuring that the total sample weight was accounted for in the final lint turnout analysis. Percent trash was calculated by dividing the trash weight collected from the extractor feeder by the total sample weight. One sample of cotton lint after the lint cleaner, from each harvesting sample were collected and sent to the Texas Tech University, Fiber and Biopolymer Research Institute in Lubbock, TX for the HVI Breeder's Test (Uster Technologies HVI 1000).

Bur cotton yield was determined by dividing the mass harvested in the 2000 ft^2 area (20 ft x 100 ft). The lint turnout for that sample was used to calculate a lint yield. Simple summary statistics were used to determine variation in yield and lint turnout. Correlation analysis was also conducted between yield and lint turnout.

Results and Discussion

Overall seed cotton yield was variable throughout each of the harvest transects. Average yield was 1890 lbs/ac, 1960 lbs/ac, and 1500 lbs/ac for transects one, two and three respectively. Transect three also had more spatial variability than the other two transects.

Figure 3 represents the seed cotton yield and lint turnout from transect one. Except for the first sample ginned the lint turnout was very consistent. There was a problem with the first gin lot that caused an exaggerated high lint turnout.

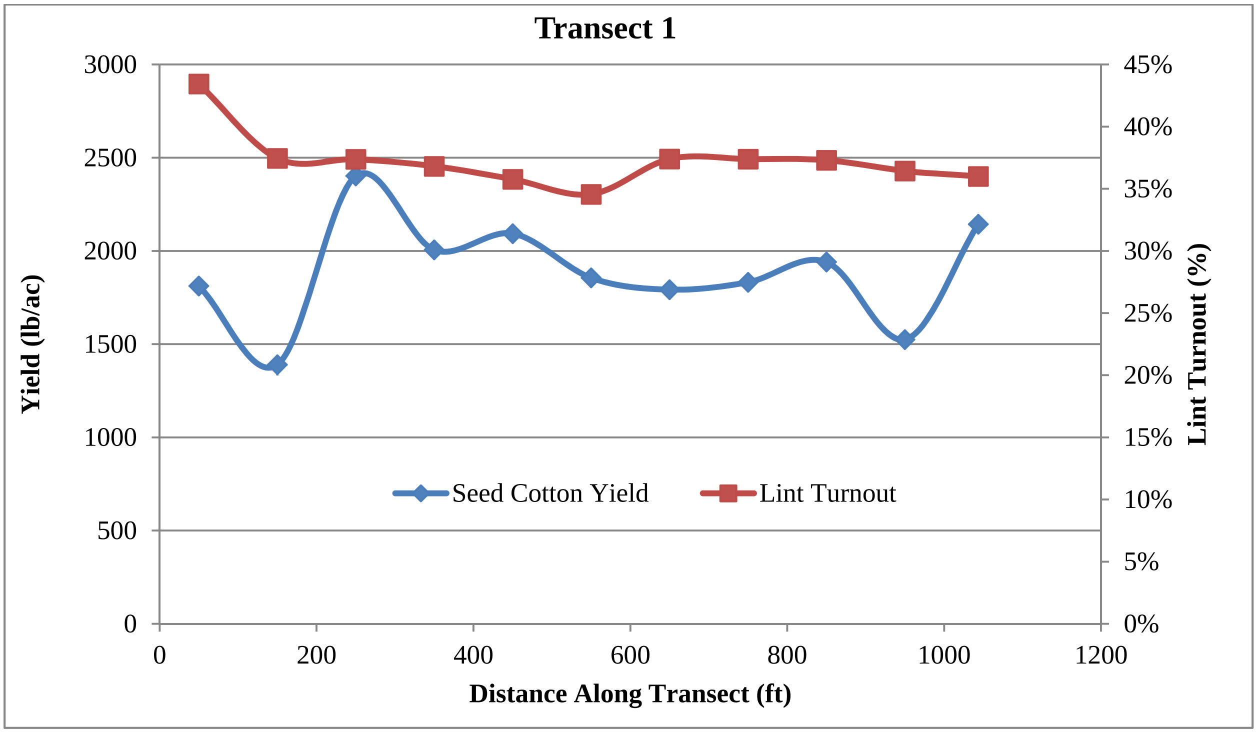

Figure 3. Seed cotton yield and lint turnout as a function of distance along transect 1.

As can be viewed in figure three the variability observed in seed cotton yield was not present in lint turnout. There was a -0.130 correlation between seed cotton yield and lint turnout. The correlation between lint yield and lint turnout was slightly higher at 0.259, however, since lint turnout was used to calculate lint yield there should be a higher correlation.

Similar results can be observed in Figure 4. Again lint turnout had very little spatial variability across transect two. Seed cotton yield in transcript two had a negative relationship with lint turnout, but still not a strong correlation. In this case seed cotton yield has a -0.298 correlation with lint turnout while lint yield only has a -0.135 with lint turnout.

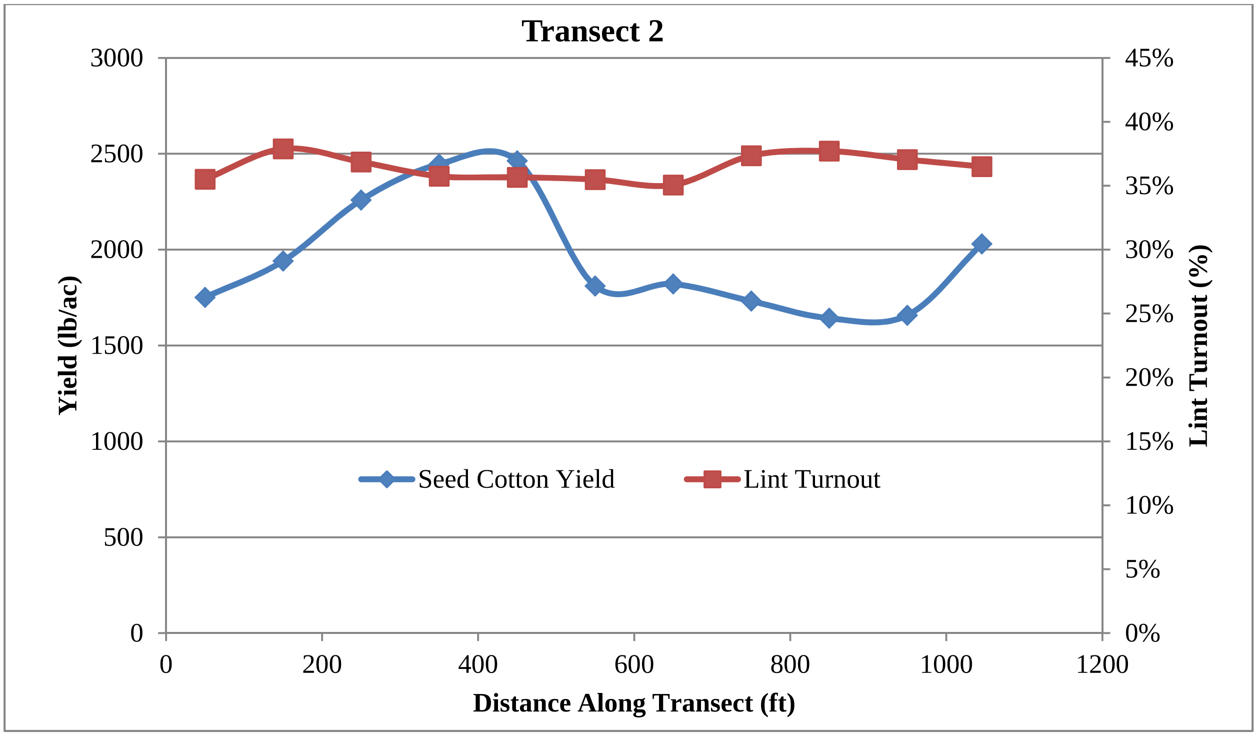

Figure 4. Seed cotton yield and lint turnout as a function of distance along transect 2.

Compared to transects one and two, transect three has a much lower average yield. However, the first two transects do not have strong correlations with lint turnout. Transect three had the highest correlations with seed cotton yield having a 0.50 correlation with lint turnout and lint yield having a 0.70 correlation with lint turnout (Figure 5). There is not enough data to fully verify but it seems that lower yielding cotton could potentially produce higher correlations between lint turnout and yield.

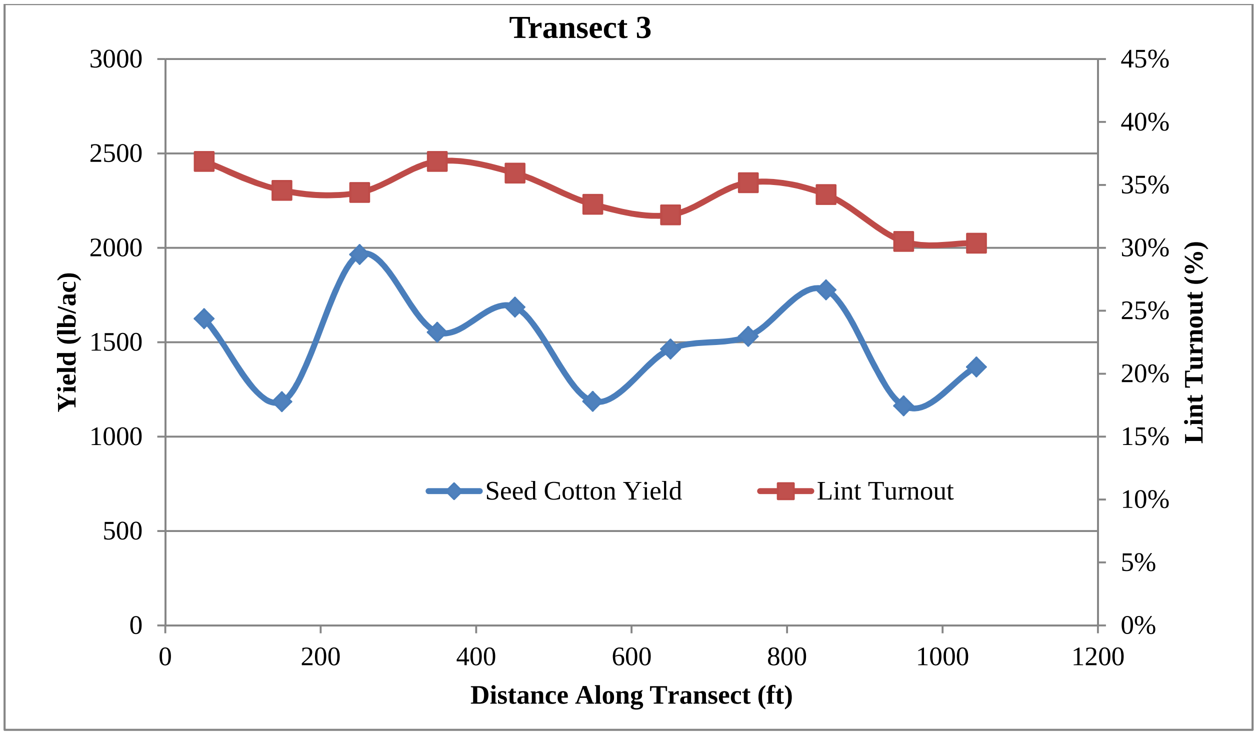

Figure 4. Seed cotton yield and lint turnout as a function of distance along transect 2.

Based on the data from this study a further study performed in very low yielding cotton could determine if the data collected from transect three is valid and representative of all lower yielding cotton or just a situation unique to this particular situation. There is not enough low yielding data in this study to draw firm conclusions about the relationship between low yielding stripper harvested cotton and variability in lint turnout.

Summary and Conclusions

It was found that lint turnout does not have a high correlation with either seed cotton or lint yield. Thus, it can be stated that higher yielding seed cotton yield does not affect lint turnout at the gin level. Thus, the variability discovered in this study is not enough to prevent accurate yield prediction. Based on the weak correlations between the higher yielding transects and both seed cotton and lint yield there is no justification to trying to determine variable lint turnout as the cotton is harvested. This study aided in putting hard numbers and correlations to seed cotton and lint yields and their correlations with lint turnout. Since the lower yielding transect had stronger correlations with lint turnout more work should be performed on very low yielding cotton to determine if spatial turnout variability increases with decreasing yield. A future study should also investigate the types of foreign matter that are causing the increasing levels of spatial turnout as the yield does decrease.

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BUR COTTON MATERIAL FLOW CHARACTERIZATION AND PARAMETERIZATION ON A BELT CONVEYOR

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Abstract

The main goal of this study was to characterize and parameterize bur cotton flow on a wire belt conveyor. This was accomplished using fiber quality and foreign matter data collected from previously determined belt configurations. Three typical yields common to the Southern High Plains (428.6, 642.9, and 857.1 kg ha^{-1} which are equivalent to1, 1.5 and 2 bale per acre yields), a one meter row width, and 5.6 km h^{-1} ground speed were used to determine three material follow rates. Four wire belt conveyor widths (0.18, 0.36, 0.53, and 0.69 m), and four material depths (0.025, 0.05, 0.10, 0.18 m), were chosen. Belt speed was determined for each of the16 width/depth combinations to achieve the three material flow rates. Fiber quality, percent foreign matter removal, and foreign matter data were collected from the extreme high and low velocities as determined by each belt width and greatest and least material flow rates and shallowest and deepest material depths (0.025 and 0.18 m) within each of the wire belt widths to determine the wire belt configuration effects on fiber quality and foreign matter content.

Introduction

Material conveyance can produce many unique challenges especially when it comes to agricultural products. Harvesters are expected to perform at an utmost level of harvesting and field efficiency during the harvest season. Baumgarten et al. (2009) investigated an assistance system for optimization of the grain combine harvest process and many of the principles can be transferred to cotton harvesters. Proper parameterization and characterization of harvesting equipment should start with individual component investigation. Studies by Porter et al. (2012 and 2013) investigated consecutive conveying/cleaning components on a cotton stripper harvester and identified and tested a redesign of the cross auger for bur cotton conveyance. Rademacher (2009) explored the harvesting and processing efficiency of a combine as related to the optimization of the machine settings. Benefits such as an increased quality of canola and wheat were observed during harvest by Rademacher (2009) from using the Claas electronic machine optimization service (CEMOS), the same system used by the Baumgarten et al. (2009) study. There are two other main parameters, independent of conveyance ability, that are the central focus for stripper harvested cotton, foreign matter content and fiber quality. Brashears and Ulich (1986) investigated pneumatic removal of fine material from bur cotton. Exhaust hoods were mounted over the stripper rolls and succeeded in removing up to 70 kg ha^{-1} but the fine material was not significantly reduced over a standard stripper harvester. Laird and Baker (1985) investigated conveying cotton on an inclined wire belt. They reported that the physical forces that control conveying of a material such as cotton on an inclined belt are frictional forces between the material and the conveying surface, flow characteristics of the conveyed material, and inertial and other forces resulting from the non-uniform flow situation. Laird and Baker (1985) reported that the rigorous mathematical theory describing the interactions of all these forces in a belt conveyor has not been developed and was beyond the scope of their study. They reported that the angle of slide, or the angle at which the cotton began to slide back down the surface was 60°, however with a compressible material such as cotton, the angle of slide may vary considerably with depth, density, trash, and moisture content, and other properties of the cotton. Also the angle of slide under non-uniform flow conditions may be less than the angle determined under static conditions (Laird and Baker 1985). The angle of slide is directly related to static and dynamic friction. Similar to the Laird and Baker (1985) the bur cotton in this study has non-uniform material composition structure and the flow characteristics can change based on material properties. The non-uniform characteristics of the bur cotton composition make it hard to predict the actual velocity and flow characteristics since the frictional forces are so variable. The principles investigated during the Brashears and Ulich (1986) study could be applied to a wire belt conveyor to employ an aided method of cleaning. Thus, this portion of the study not only investigates bur cotton conveyance on a wire belt but works towards characterizing foreign matter content and fiber quality associated with various belt widths, speeds and depths.

Materials and Methods

This section expands on Porter et al. (2013) and explores various speeds, depths, and widths on a wire belt conveyor. Data from Porter et al. (2013) supported the idea that a wire belt conveyor can be used as a viable replacement for a cross auger on a cotton stripper. A FiberMax 9170 B2F cultivar was used for this study.

To properly design and optimize a wire belt for conveying bur cotton, multiple material conveyance parameters needed to be tested and quantified. A standard field harvest speed of 5.6 km h^{-1} (3.5 m h^{-1}) was used in combination with three estimated common bur cotton yields observed in the Southern High Plains: 429, 643, and 857 kg lint ha^{-1} (1, 1.5 and 2 bale ac^{-1} yields). The speed and yields in combination with a one row (1 m) harvest width equate to 0.30, 0.45, and 0.60 kg s^{-1} of material flow respectively. A wire belt conveyor was built with 0.69 m in width. The wire belt had rectangular slots that were 1.27 cm by 2.54 cm (Figure 1). The belt conveyor was driven by a single v-belt using a 110 volt electric motor with a variable frequency drive (Figure 2).

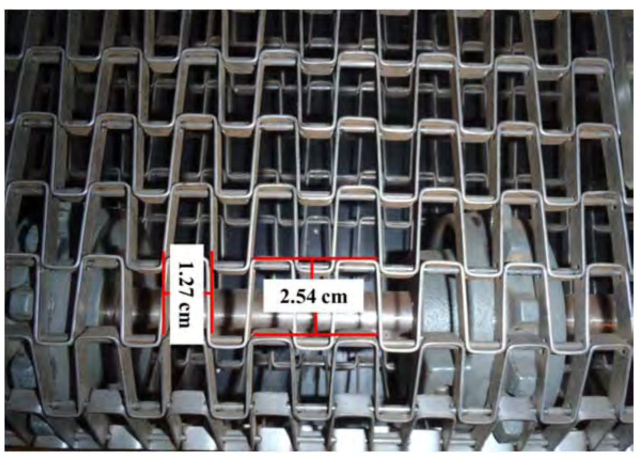

Figure 1. The dimensions of the wire belt that was used for the wire belt conveyance of bur cotton.

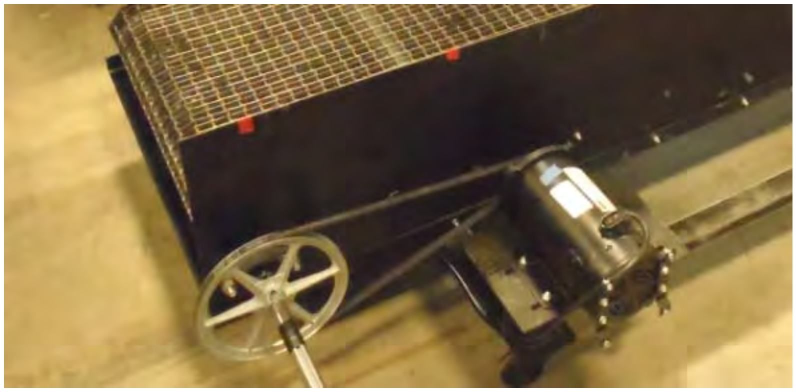
Figure 2. The motor and drive belt that operated the wire belt conveyor.

Four belt widths were tested: 0.18 m, 0.36 m, 0.53 m and 0.69 m. The minimum and maximum widths were determined based on the width of the current auger trough on a cotton stripper. The minimum width was half and the maximum width was double that of the current width of the auger trough on a John Deere 7460 cotton stripper. The width of the belt conveyor was made adjustable by a divider (Figure 3) that was designed to fit over the top of the wire belt conveyor. The divider had slotted rails so it could be set to any width. Four depths were chosen, 0.03 m, 0.05 m, 0.10 m, and 0.18 m. Belt speeds were calculated based on these depths. As with any material conveyance there is a minimum and maximum speed that would be feasible for field operation. Thus the calculated belt speed was set throughout the tests based on the width and depth settings. Belt speed was controlled by a variable frequency drive on the drive motor and an optical tachometer was used to measure the speed of the belt head-shaft. The test matrix represents the test combinations that were used for the fiber quality data collection (Table 1). The red highlighted fields represent velocities deemed non practical because they were either too slow or too fast for the electrical motor. The eliminated speeds are not practical from a field harvesting standpoint as these extreme velocities would be either much slower or faster than bur cotton would be introduced into the machine. Slower velocities could lead to greater material depths and potential clogging within the wire belt conveyance trough slowing and even disrupting harvest in certain cases. Extremely fast velocities would never allow the wire belt to be fully loaded and perform under full load. The fast velocities could also introduce other issues such as high power requirements and potential for increased wear to moving parts on the wire belt conveyor.

Table 1. Test matrix that was used for testing the wire belt conveyor for high speed camera and fiber quality work (velocities highlighted in red were not performed due to being non practical.

Width (Meters)	**0.03 m Material Depth**	**0.05 m Material Depth**	**0.10 m Material Depth**	**0.18 m Material Depth**
Velocities (m/s) for 0.30 kg s^{-1} of Material Flow				
0.18	2.05	1.03	0.51	0.29
0.36	1.03	0.51	0.26	0.15
0.53	0.68	0.34	0.17	0.10
0.69	0.53	0.27	0.13	0.08
Velocities (m/s) for 0.45 kg s^{-1} of Material Flow				
0.18	3.08	1.54	0.77	0.44
0.36	1.54	0.77	0.38	0.22
0.53	1.03	0.51	0.26	0.15
0.69	0.80	0.40	0.20	0.11
Velocities (m/s) for 0.60 kg s^{-1} of Material Flow				
0.18	4.11	2.05	1.03	0.59
0.36	2.05	1.03	0.51	0.29
0.53	1.37	0.68	0.34	0.20
0.69	1.06	0.53	0.27	0.15

The wire belt speeds were calculated and followed the material flow rates as they relate to the estimated common selected yields. Table 1 contains 48 tests, but due to the impractical speeds, only 43 tests were actually completed. The wire belt velocities ranged from 0.08 m s^{-1} to 4.10 m s^{-1} or 14 rpm to 770 rpm on the shaft attached to the drive pulleys on the wire belt conveyor. The current auger design on the cotton stripper moves material laterally at approximately 2.0 m s^{-1}. The current auger design is rated much faster than required for the material flow rates selected for this test. Thus the velocity ranges selected for this test covered a full range of speeds to adequately evaluate a wire belt conveyor.

A bur cotton bat (Figure 3) was placed on the wire belt conveyor equivalent to one row in width or 1.0 m. The bur cotton bat was placed at the appropriate depth on the wire belt conveyor. Guide marks (Figure 3) were placed on the divider to ensure the appropriate depth was matched.

Figure 3. The guide marks on the divider were used to ensure the bur cotton bat was placed at the appropriate depth and can be seen on the right to the far end of the wire belt conveyor.

Figure 4. The high speed camera and the belt conveyor with the plexi-glass side installed.

To aid with the characterization and parameterization process, fiber quality samples were collected from the lowest and highest material flow rate and minimum and maximum depths of the belt conveyance tests for all four belt widths for a total of four replications. The data from Porter et al. (2013) has shown that a belt conveyor does not have a significant impact on foreign matter content or fiber quality when compared to the standard auger conveyance method. Due the low impact on evaluated fiber quality parameters from Porter et al. (2013), only select tests were used to collect foreign matter content and fiber quality samples. It was decided to select extreme testing parameters to aid in discovering differences between wire belt configurations. Thus the 0.45 kg s^{-1} material flow rate was eliminated from this test, leaving only the remaining 0.30 and 0.60 kg s^{-1} material flow rates. Thus not collecting all of the wire belt conveyor configurations was justified. Potential optimization work could be performed on a belt conveyance system to aid in foreign matter removal and further preservation of fiber quality. Table 16 represents the test matrix that was used to determine the testing parameters for this study. The use of the extreme wire belt parameters should show relationships, if they exist, without the testing of every belt configuration necessary.

Table 2. Test matrix that was used for testing the wire belt conveyor for fiber quality work.

Width (Meters)	**0.03 m Material Depth**	**0.18 m Material Depth**
Velocities (m/s) for 0.30 kg s^{-1} of Material Flow		
0.18	2.5	0.29
0.36	1.03	0.15
0.53	0.68	0.10
0.69	0.53	0.08
Velocities (m/s) for 0.60 kg s^{-1} of Material Flow		
0.18	4.11	0.59
0.36	2.05	0.29
0.53	1.37	0.20
0.69	1.06	0.15

A total of four replications were collected for each belt configuration from Table 2. Separated foreign matter was collected and weighed after each run from the bottom of the conveyance trough for all samples including those performed during the high speed camera analysis. The bur cotton samples were collected at the end of the conveyor belt into a container, weighed on an Electroscale (Model LC2424, capacity: 99.8 kg, Display: Electroscale Weigh Master 551, capacity: 90.7 kg, resolution 0.005 kg), and then transferred to be prepared for ginning. Since this was bur cotton, all samples were processed through an extractor feeder prior to ginning to ensure the ginning process was consistent. A fractionation sample was collected from each bur cotton sample prior to passing through the extractor feeder and was processed as outlined by USDA (Shepherd 1972). An A&D Company Ltd. (Model: HP 20K, Serial No.: 13013097, Capacity: 21 kg, resolution 0.1 g) scale was used for weight collection of the fractionation data. Due to the small sample size (usually <4.5 kg), the samples were ginned on a 10 saw gin. Due to the differences in sample sizes and potential time requirements for ginning large samples on a small gin, sub-sample sizes were limited to 1.5 kg. If the sample was smaller than 1.5 kg then the entire sample was ginned, if larger than 1.5 kg then only 1.5 kg was ginned. The clean lint was collected and weighed along with the trash and seeds to obtain lint turnout and a lint sample was taken and sent to the Texas Tech University, Fiber and Biopolymer Research Institute in Lubbock, TX for HVI (Uster Technologies HVI 1000) and AFIS (Uster Technologies AFIS Pro 2) fiber analysis. Analysis of Variance (ANOVA) was performed using the Minitab Statistical Software version 16 (Minitab Inc. State College, PA). Tukey's Studentized Range test was used to declare differences among treatment means ($\alpha = 0.10$). An alpha level of 0.10 was used since this was preliminary and exploratory work.

Results and Discussion

Results from the foreign matter content and cotton fiber quality analysis provided insight into speed, width, depth, and material flow rate effects on foreign matter content and fiber quality. Figure 5 shows the amount of foreign matter removed from each sample as it passed across the wire belt conveyor. As the material depths increased in Figure 5 the velocities were reduced. A lower material depth required a higher velocity to transport the same amount of material than a greater depth. The data show that a lower material depth promotes an increase in foreign matter removal. There is not a statistical relationship but there appears to be an optimal speed in each of the material depths that also promotes an increase in foreign matter removal (Figure 5). The highest levels of foreign matter removal occurred at the 0.03 and 0.05 m material depths. It appears that an optimal velocity for the 0.03 m depth ranges from approximately 0.5 to 1.5 m s^{-1} and an optimal velocity for the 0.05 m depth ranges from approximately 0.35 to 1.00 m s^{-1}. There do appear to be a few points that had much higher than average foreign matter removal percentages, but since this particular test was not replicated because the data were collected from all runs and not the reduced replicated tests, firm conclusions cannot be drawn. On a percent removal basis greater material depths remove less material than the lower material depths.

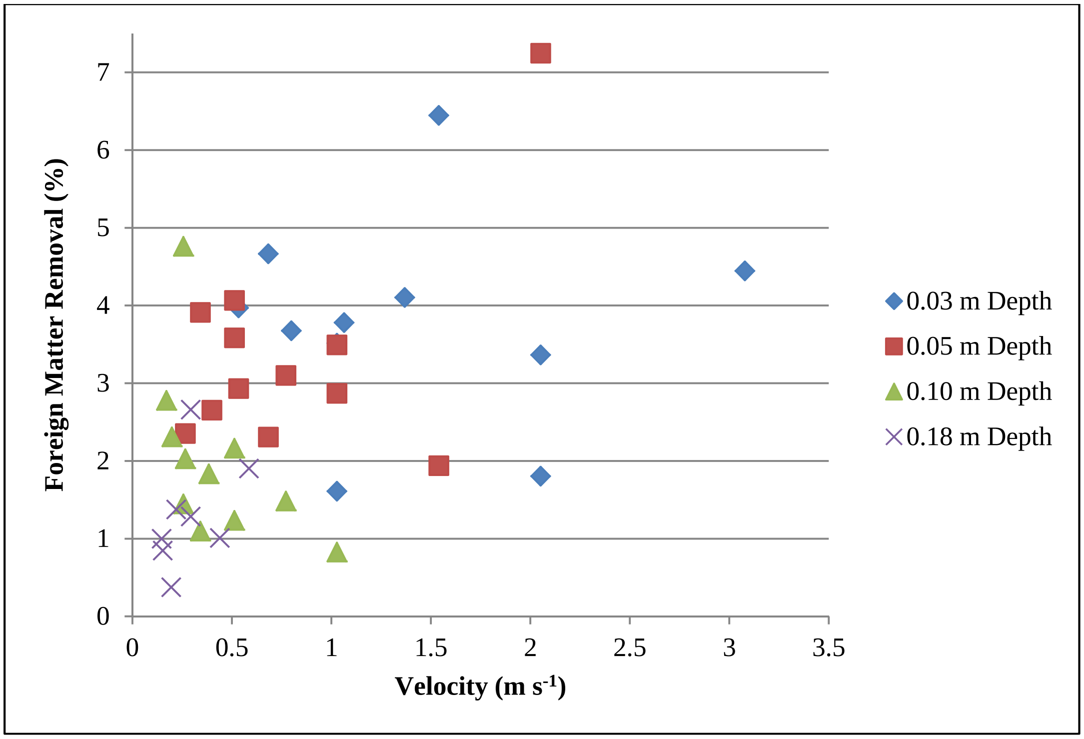

Figure 1. Percentage of foreign matter removed from the bur cotton by the wire belt conveyor based on bur cotton material depth.

The data represented in Figure 5 was collected from material pneumatically removed from the bottom of the wire belt conveyor and collected from the floor. The faster velocity could introduce a higher rate of vibration that accounts for a higher amount of material removal. As would be expected, a deeper depth did not incur a higher amount of foreign material removal. The same surface area of material was allowed to touch the wire belt independent of the material depth, verifying that foreign matter is only being removed from the portion of the bur cotton that is allowed to touch the belt. Approximately the same amount of foreign matter was collected from each sample, thus the data is presented as percent removal of foreign matter from each sample to aid normalizing this data collection. The sample size varied with each wire belt conveyor configuration such that smaller samples had the same amount of foreign matter collected as did the larger samples; however, in terms of percent removal the smaller samples had higher values since the weight of the foreign matter comprised a higher amount of the total sample weight. Thus, typically a shallower depth had a higher percent removal per sample size than did the deeper material depths. The mixing action of a cross auger aids in inverting and mixing the bur cotton allowing for foreign material to not only be removed from the bottom of the material flow, but from the entire material flow stream. However, the mixing action of a cross auger could also intermix foreign material making it more difficult to remove during later processes. The non-mixing flow action of a wire belt conveyor should make it easier to remove foreign material within the field cleaner and perhaps at the gin level because it prevents foreign matter from being further incorporated into the bur cotton.

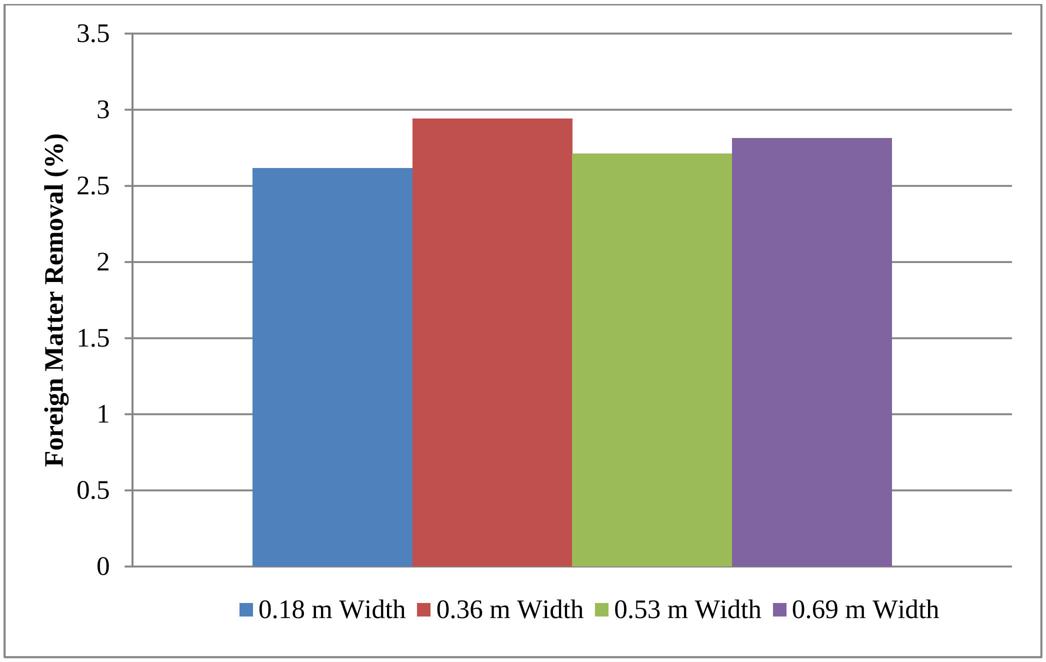

Figure 2. Percentage of foreign matter removed from the bur cotton by the wire belt conveyor based on wire belt width.

Figure 6 shows the percent removal of foreign matter based on the width of the wire belt conveyor. According to this data the 0.36 m wide belt performed best at removing foreign matter, with the 0.69 m wide belt removing approximately 0.1% less. However, it is important to note that there is only about a 0.3% difference between the highest and lowest foreign matter removals. After pairing this data with the depth and speed data, optimal ranges and widths can be determined and appear to range from 0.36 to 0.69 m in width, 0.5 to 1.5 m s^{-1} in velocities and the material depth should stay at or below 0.05 m.

There were no statistical differences among the widths for lint turnout. Table 3 represents the mean groupings of the lint turnout data grouped by width.

Table 3. Lint turnout grouped by width of the wire belt conveyor.

Width (m)	**Lint turnout % Lint**
Untreated	37
0.18	38
0.36	38
0.53	36
0.69	36
P-Value	0.066

Greater belt widths had slightly lower lint turnouts than did the narrower belt widths. This could potentially be attributed to sample size, because typically the narrower widths were comprised of smaller samples, or it could just be because of natural variations in the cotton samples. All of the lint turnout numbers are high based on typical turnouts from stripper harvested bur cotton. However, the use of a small scale gin can sometimes increase the lint turnout and have other adverse effects on fiber quality parameters due to a few reasons such as differences in gin stand design and environmental conditions during ginning (Boykin et. al 2008). Since less sample flow is travelling through the gin, it may perform better at retaining more lint, or the smaller gin does not perform well at removing foreign material thus increasing the lint weight and consequently lint turnout.

Slight variations were observed in lint turnout when velocity was used as a factor. Table 4 presents the lint turnout divided by both width and material conveyance. Turnout tended to be slightly higher at low flow rates and minimum material depths. This could be attributed to more removal of foreign material occurring during the conveyance process of the bur cotton. However, the differences are slight and may not mean there is much difference between the material conveyance rates and depths.

Table 4. Percentage of foreign material removed from the bur cotton ginning based on material flow rate.

Width (m)	**Lint turnout %**	
	0.30 kg s^{-1} of Material Flow	**0.60 kg s^{-1} of Material Flow**
P-Value	<0.0001	
Untreated	37.1^{BC}	
0.18	41.0^{A}	36.2^{C}
0.36	38.5^{B}	36.2^{C}
0.53	36.2^{C}	36.5^{C}
0.69	36.6^{C}	35.6^{C}

To determine if the different combinations of speed, depth, and material flow rate had any effects on the type of foreign material being removed, the fractionation samples were collected and analyzed by all of the wire belt configurations. Differences were only significant for a few of the wire belt configurations tested. Leaf trash did have a significant relationship with width (Table 5).

Table 52. Leaf trash grouped by width for the wire belt conveyor reported from fractionation results.

Width (m)	**Leaf Trash % of Sample**
Untreated	3.0^{A}
0.18	2.9^{AB}
0.36	2.5^{AB}
0.53	2.7^{AB}
0.69	2.4^{B}
P-Value	0.042

An increase in belt width seemed to reduce the total amount of leaf trash present in the samples. However there was not a statistical difference between the samples. This is potentially due to more surface area of the bur cotton being allowed to touch the wire belt conveyor. The area touching the belt allowed more of the leaf trash to be removed from the sample as it passed along the conveyor than did the reduced areas of the narrower widths. The only other significant interaction occurred between leaf trash as analyzed by depth and material flow rate (Table 6).

Table 6. Percentage of leaf trash present measured by fractionation procedures.

Width (m)	**0.03 m Depth % Leaf Trash**	**0.18 m Depth % Leaf Trash**
P-Value	0.012	
Untreated	3.02^{A}	
	0.30 kg/s Material Flow	
0.18	2.6^{AB}	3.2^{A}
0.36	2.2^{AB}	2.8^{AB}
0.53	2.7^{AB}	Not Collected
0.69	2.3^{AB}	Not Collected
	0.60 kg/s of Material Flow	
0.18	Not Collected	2.8^{AB}
0.36	2.3^{AB}	3.0^{AB}
0.53	2.8^{AB}	2.6^{AB}
0.69	2.1^{B}	2.9^{AB}

Again, the differences are minor, but the lower percentages of leaf trash tend to occur at the lowest depths and the greatest widths. This again supports that a faster velocity could introduce higher vibration levels that could aid in shaking out more foreign material, especially in these cases the leaf trash. The greater widths are allowing for more surface area of the conveyed bur cotton to be exposed to the open wire belt. The increase in exposure to the belt provides both an open area for the leaf trash to fall out and introduces more vibration to the material touching the wire belt. The increases in vibration at this point aid in removing foreign material from the bur cotton.

Larger trash such as burs, sticks, and stems may not be able to fall through the belt since typically they are larger than the openings of the belt. More research into belt design could aid in increasing the amount of larger sized trash that is removed from the bur cotton. However, this process must be taken with care to ensure that the burr cotton is not allowed to fall out of the material stream, effectively reducing yield and decreasing harvest efficiency.

Both HVI and AFIS results, similar to the turnout and fractionation results did not have significant differences in the treatments for many of the HVI parameters including micronaire, strength, reflectiveness, and yellowness. Minor significant differences were present for HVI length, uniformity, elongation, and leaf. The HVI parameters with differences are presented in Table 7 below. The letters only correspond to the statistical differences located within each column data and do not correspond to any other HVI parameter in the table.

Table7. HVI parameters containing statistically significant differences based on treatment.

Treatment: Material flow rate, width, depth	Length (cm)	Uniformity %	Elongation	Trash (%)
Untreated	3.0^{AB}	81.9^{AB}	7.6^{A}	67.0^{AB}
0.30, 0.18, 0.03	3.0^{AB}	82.0^{AB}	7.2^{B}	34.5^{B}
0.30, 0.18, 0.18	3.0^{B}	81.0^{B}	7.6^{A}	57.0^{AB}
0.60, 0.18, 0.03	Not Collected	Not Collected	Not Collected	Not Collected
0.60, 0.18, 0.18	3.0^{AB}	82.4^{AB}	7.6^{A}	61.8^{AB}
0.30, 0.36, 0.03	3.1^{AB}	82.5^{AB}	7.7^{A}	50.5^{AB}
0.30, 0.36, 0.18	3.1^{AB}	83.3^{A}	7.6^{A}	84.3^{A}
0.60, 0.36, 0.03	3.0^{B}	81.8^{AB}	7.9^{A}	53.5^{AB}
0.60, 0.36, 0.18	3.0^{AB}	82.3^{AB}	7.6^{A}	72.3^{AB}
0.30, 0.53, 0.03	3.1^{A}	83.2^{A}	7.6^{A}	64.0^{AB}
0.30, 0.53, 0.18	Not Collected	Not Collected	Not Collected	Not Collected
0.60, 0.53, 0.03	3.0^{AB}	82.8^{AB}	7.6^{A}	75.5^{A}
0.60, 0.53, 0.18	3.1^{AB}	82.5^{AB}	7.6^{A}	67.8^{AB}
0.30, 0.69, 0.03	3.1^{AB}	83.1^{A}	7.7^{A}	56.3^{AB}
0.30, 0.69, 0.18	Not Collected	Not Collected	Not Collected	Not Collected
0.60, 0.69, 0.03	3.1^{AB}	82.4^{AB}	7.7^{A}	53.3^{AB}
0.60, 0.69, 0.18	3.1^{A}	83.0^{A}	7.6^{A}	83.8^{A}
P-Values	0.008	0.009	<0.0001	0.012

As presented in Table 7, most of the differences present are slight and even though they are statistically different at α=0.10 levels, the difference in actual fiber quality is not necessarily practical. There do not appear to be any trends present that correlate the fiber quality variation to the depth, width, and speed of material conveyance on the wire belt. AFIS results presented no statistical differences in fiber quality parameters tested, and variability was noted just as in the HVI data. The slight variations observed in the fiber quality data can be attributed to natural field variation on sampling and ginning methods. The set-up and evaluation of machinery projects often leave no feasible opportunities for treatment randomization. Even when considering the nature of this particular project, the foreign matter and fiber quality data do not seem to follow a trend that would suggest the issues could have been resolved by adjusting the testing procedures. As is often the case when working with natural environments, the variation present shows up in the data as slight differences with little to no pattern. Thus, it appears that various configurations of a wire belt conveyor do not seem to have a significant effect on cotton fiber quality parameters.

Summary and Conclusions

Cotton fiber quality and foreign matter content samples were processed across four widths combined with two depths on a wire belt conveyor to produce two material conveyance rates. The combination of width, depth, and material conveyance rate was used to determine the speed at which the wire belt conveyor should be operated at. The minimum and maximum conditions were tested for this part of the study. It was decided to use two material flow rates that would be considered high and low in the Southern High Plains. The fastest and slowest possible velocities were selected. Fractionation, ginning, HVI, and AFIS data were collected from these testing parameters. There were slight differences present from these processes and fiber quality tests. The various wire belt conveyor configurations did not have significant impacts on lint turnout, HVI and AFIS results. However, percent removal data collected from the wire belt conveyor suggest an optimal belt configuration to ensure higher levels of foreign matter removal. The optimal belt configurations based on the percent foreign matter removal data are velocities ranging from 0.5 to 1.5 m s^{-1}, widths ranging from 0.36 to 0.69 m and material flow depths less than 0.10 m. Since the percent removal data was the only data that show significant differences between wire belt conveyor configurations it was used to determine optimum settings. Designing a belt conveyor to meet these specifications would optimally increase the amount of foreign matter removed from bur cotton as it passes along a wire belt to higher levels than other belt configurations. Most of the differences present in the foreign matter and fiber quality parameters that were statistically different were not of practical significance. The results of these tests have aided in developing a foundation for wire belt conveyance and fiber quality parameters and foreign matter removal. This foundation can be used to further optimize a wire belt conveyor for conveying bur cotton.

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Peer Reviewed Journal Article

Extension Cotton Specialist Working Group – Effects of Nitrogen and Planting Seed Size on Cotton Growth, Development and Yield

Nitrogen is frequently the plant nutrient provided to cotton in the greatest quantity. But occasionally N is not used efficiently by the crop. Applied N may not be available because of runoff, leaching, and/or volatilization. Such losses represent unrecovered input costs for growers and potentially detrimental effects to the environment. In recent years, prices of N fertilizers have increased and been more volatile. Thus, there are both economic and environmental motives for improving the efficiency of N fertilization practices. Cotton will take up ammonium (NH_4) and nitrate (NO_3) nitrogen from all sources, including fertilizer, atmospheric deposition in rain water, irrigation water, soil water, and soil mineralization N release. While soil NO_3 testing is not extensively used in some states in cotton production, pre-plant soil NO_3 testing could prove to be economically beneficial, especially where large quantities of residual NO_3 are present. **A common experiment funded by the Cotton Incorporated Core Program was performed by state cooperative extension cotton specialists at ten locations each in 2009 and 2010.** At each location, the experiment was a factorial arrangement of three cultivars and four N rates (0, 40, 80, and 120 lb N/acre). Locally adapted cultivars were chosen that had seed counts per lb in the following three classes, large (< 4400), medium (4401-5000) and small seeds (> 5000 seed/lb). A Cotton Incorporated sponsored producer publication is being generated at this time and should be available soon. The general conclusions from this work are as follows:

- Base N application rates on anticipated yields of the field or site-specific zone. Field production records and performance of cultivars in replicated field tests on similar soils in your region provide good references for estimation.
- For the yield levels encountered in these trials (no sites produced over 4 bales/acre), these results indicate that cotton needed approximately 50-55 lbs N/bale from all sources (including soil and water inputs). Pre-plant soil nitrate –N can be deducted from the application rate for applied N without sacrificing yield.
- Over fertilization with N will delay maturity, make defoliation more difficult, and if excessive can reduce lint yields.
- To potentially improve N use efficiency, apply N as close to the time the crop will use it as possible. To avoid losses to denitrification and leaching apply split applications by using starter fertilizer and applying the remainder 30-40 days post plant or applying one third of the total at pre-plant and the remainder as if following a starter application.

Effects of Nitrogen and Planting Seed Size on Cotton Growth, Development, and Yield

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ABSTRACT

A standardized experiment was conducted during 2009 and 2010 at 20 location-years across U.S. cotton (*Gossypium hirsutum* L.)-producing states to compare the N use requirement of contemporary cotton cultivars based on their planting seed size. Treatments consisted of three cotton varieties with planting seed of different numbers of seed per kg and N rates of 0, 45, 90, and 134 kg ha^{-1}. Soil at each trial location was sampled and tested for nitrate presence. High levels of soil nitrate (>91 N-NO_3^- kg ha^{-1}) were found in Arizona and western Texas, and soil nitrate in the range of 45 to 73 kg N-NO_3^- ha^{-1} was found at locations in the central United States. Cotton lint yield responded to applied N at 11 of 20 locations. Considering only sites that responded to applied N, highest lint yields were achieved with 112 to 224 kg ha^{-1}of applied plus pre-plant residual soil NO_3—translating to an optimal N requirement of 23 kg ha^{-1} per 218 kg bale of lint produced. Among the varieties tested those with medium-sized seed produced higher yields in response to N than did larger and smaller seeded varieties. Varieties with larger seed had longer and stronger fibers, higher fiber length uniformity than small seeded varieties and decreased micronaire. Seed protein and oil increased and decreased slightly in response to increasing amounts of soil nitrate plus applied N, respectively.

Nitrogen is frequently the plant nutrient provided to cotton in the greatest quantity, but often N is not used efficiently by the crop (Hunt et al., 1998; Hutmacher et al., 2004). Applied N may not be available to the crop because of runoff, leaching, and volatilization. Such losses represent unrecovered input costs for the grower and potentially detrimental effects to the environment (Galloway et al., 2008). Moreover, in recent years prices of N fertilizers have increased and have been increasingly volatile (USDA-ERS, 2012). Thus, there are both economic and environmental motives for improving the efficiency of N fertilization practices.

A compounding problem with selecting a single optimum N rate for cotton compared to grain crops is in part due to cotton's physiology. In contrast to grain crops that were selected from wild annual plants, cotton varieties are derived from arborescent perennials that can be highly indeterminate in growth and reproduction patterns (Donald and Hamblin, 1976; Bednarz and Nichols, 2005). Partitioning of N in cotton is affected by genetics, environment, and the availability of N (Mullins and Burmeister, 1990; Boquet et al., 1993; Boquet and Breitenbeck, 2000; Fritschi et al., 2003). Cotton varieties that receive supraoptimal N may produce excessive vegetative growth and fewer reproductive structures than cotton receiving less N (Boquet et al., 1994; Boquet and Breitenbeck, 2000). Increasing N fertilization may increase cottonseed yield more than lint yields (Egelkraut et al., 2004; Fritschi et al., 2003).

Pre-sidedress soil nitrate tests (PSNT) have shown promise in predicting N fertilizer needs for other crops. Spellman et al. (1996) reported that critical levels for PSNT NO_3^- for corn production were lower in semiarid areas of the western United States than in more humid environments. Similar results were reported in Australia where soil NO_3^- levels sampled to a depth of 30 cm before planting were closely correlated to cotton N uptake in plots that received no applied N fertilizer (Constable and Rochester, 1988). While soil NO_3^- testing is not currently used to a great extent for cotton production, this type of testing could prove to be economically beneficial in areas where residual NO_3^- is present.

Cotton lint is comprised of fibers growing from the cotton seed surface. Because a large number of small seed can have more surface area than do a few large seed, greater lint yields might be achieved by selecting for reduced seed size and increasing seed numbers (Harrell and Culp, 1976). Such a result could accrue from simple selection for high gin turnout, the fraction of lint obtained from harvested seed cotton. In fact the mean seed size of cotton varieties has been decreasing for the last 30 yr (Bednarz et al., 2007).

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Abbreviations: PSNT, pre-sidedress soil nitrate tests.

Table 1. Summary of trial locations, soil types, and cotton varieties† planted at each location representing each seed size class.

Location	Years	Soil type	Seed sizes, no. seed kg^{-1}		
			<9700	9701–11,000	>11,001
Arkansas	2009–2010	silt loam	ST 5288B2F	DP 0924 B2RF	FM 1740B2RF
Arizona	2009	clay loam	DP 164 B2RF	ST 4498B2RF	PHY 745 WRF
	2010	clay loam	ST 5288B2F	DP 0924 B2RF	FM 1740B2RF
Georgia	2009	sandy loam	DP 555 BG/RR	PHY 485 WRF	FM 1740B2RF
Kansas	2010	sandy loam	ST 5288B2F	DP 0924 B2RF	FM 9180B2F
Mississippi	2009–2010	loam	ST 5288B2F	DP 0924 B2RF	FM 1740B2RF
North Carolina	2009–2010	sandy loam	ST 5288B2F	DP 0912 B2RF	FM 1740B2RF
Oklahoma	2009	clay loam	DP 164 B2RF	ST 4554B2RF	FM 9180B2F
	2010	clay loam	ST 5288B2F	DP 0924 B2RF	FM 9180B2F
South Carolina	2009–2010	sandy loam	DP 555 BG/RR	DP 0935 B2RF	PHY 745 WRF
Tennessee	2009–2010	silt loam	ST 5288B2F	DP 0920 B2RF	FM 1740B2RF
South Texas	2009–2010	silty clay loam	DP 0949 B2RF	DP 0935 B2RF	FM 840B2F
West Texas	2009	clay loam	DP 161 B2RF	FM 9058F	FM 9180B2F
	2010	clay loam	ST 5288B2F	DP 0924 B2RF	FM 9180B2F

† DP = Deltapine, Monsanto Company, 800 N. Lindbergh Blvd., St. Louis, MO 63167; FM = FiberMax, Bayer CropScience, 2 TW Alexander Drive, Research Triangle Park, NC 27709; PHY = PhytoGen Cotton Seed, Dow AgroSciences LLC, 9330 Zionsville Road, Indianapolis, IN 46268; ST = Stoneville, Bayer CropScience, 2 TW Alexander Drive, Research Triangle Park, NC 27709.

The cotton crop produces lint, whole seed for ruminant feed, cottonseed meal, a source of protein, and cottonseed oil, as well as hulls, a source of roughage, and linters, a source of cellulose. Since cotton seeds are a N sink (Egelkraut et al., 2004), maximum lint yields might be achieved with lower rates of N than previously were recommended for cotton production. Use of relatively low N rates for the fertilization of small-seeded cotton varieties may change the distribution of products produced by cotton and the distribution of N among cotton products from that expected with larger seeded varieties. The objective of this research is to compare the N use requirement of contemporary cotton cultivars based on their planting seed size.

MATERIALS AND METHODS

A standardized experiment was conducted by state cooperative extension cotton specialists at 20 locations during 2009 and 2010 (Table 1). At each location, the experiment was implemented as a factorial arrangement of three varieties and four N rates within a randomized complete block design with four replications of treatments. The three cotton seed size classes were selected with seed counts kg^{-1} in the following ranges, <9700 (large), between 9701—11,000 (medium), and >11,001 (small). A locally-adapted variety from each seed-size class was selected at each location. Nitrogen rates were 0, 45, 90, and 134 kg N ha^{-1} applied as a side-dress treatment between planting and the pinhead square stage of cotton development. Nitrogen fertilizer source was selected at each trial location according to locally available sources and practices.

The cations, Ca, Mg, and K; and extractable P were determined according to state soil laboratory procedures in the respective states. Except as noted in the experimental design, the crops were managed for high yields according to each respective states' University Extension recommendations. Soil samples were extracted from each plot at the 0- to 15- and 15- to 60-cm depth before planting and N application. Soil nitrate was determined in all samples (Bremner, 1965). Stand counts were recorded 10 to 14 d after planting (DAP) to ensure a uniform crop was established for each trial. Cotton vigor was monitored by recording the number of nodes above the highest first position white flower (NAWF) weekly from first bloom through defoliation (Bourland et al., 2001). At 120 DAP, plant height, number of plant nodes, number of bolls, and nodes above the highest first position cracked boll (NACB) to the highest harvestable boll were recorded (Bourland et al., 1992). The date when each treatment reached 60% open boll was recorded, and the cotton defoliated as soon thereafter as possible. The two center rows of each four to eight row plot were harvested using spindle pickers modified for small-plot harvesting at all locations except in Altus, OK, and Lubbock, TX, where a cotton stripper harvester was used. A sample of mechanically harvested seedcotton was collected from each plot and used to determine lint percentage and fiber quality. Gin turnout and lint yields were recorded, and ginned 50 g lint samples were sent to Cotton Incorporated where fiber properties were measured using a Model 1000 Uster High Volume Instrument (Sasser, 1981). Fuzzy cotton seed index was determined by counting the number of ginned seed in three 100-g samples.

Oil and protein content of the seed were quantified in samples of fuzzy seed by chemometric analysis using pulsed-field, time-domain ^{1}H nuclear magnetic resonance (TD-NMR) as previously developed (Horn et al., 2011) with a few modifications. The NMR signals were recorded on a modified Bruker minispec mq20 NMR analyzer (Bruker Optics, Inc, The Woodlands, TX). A newly-designed probe (PA247) with shorter dead time (29 µs) was installed in the mq20 spectrometer to acquire additional solid-echo signal and enhanced overall signal quality that improved the prediction of protein values from cottonseed. Algorithms for the calculation of oil and protein values were developed by generating a standard curve and by multivariate analysis, respectively, with a diverse reference seed set (Horn et al., 2011). Values for each sample were reported as mean weight percent from three independent samples of approximately 3 g of seed.

Data were subjected to statistical analysis using the PROC MIXED procedure of the Statistical Analysis System (SAS version 9.2; SAS Institute, Cary, NC). A preliminary analysis reviled no interaction of the main effects, seed-size classes and N rates with locations and years. Each year–location

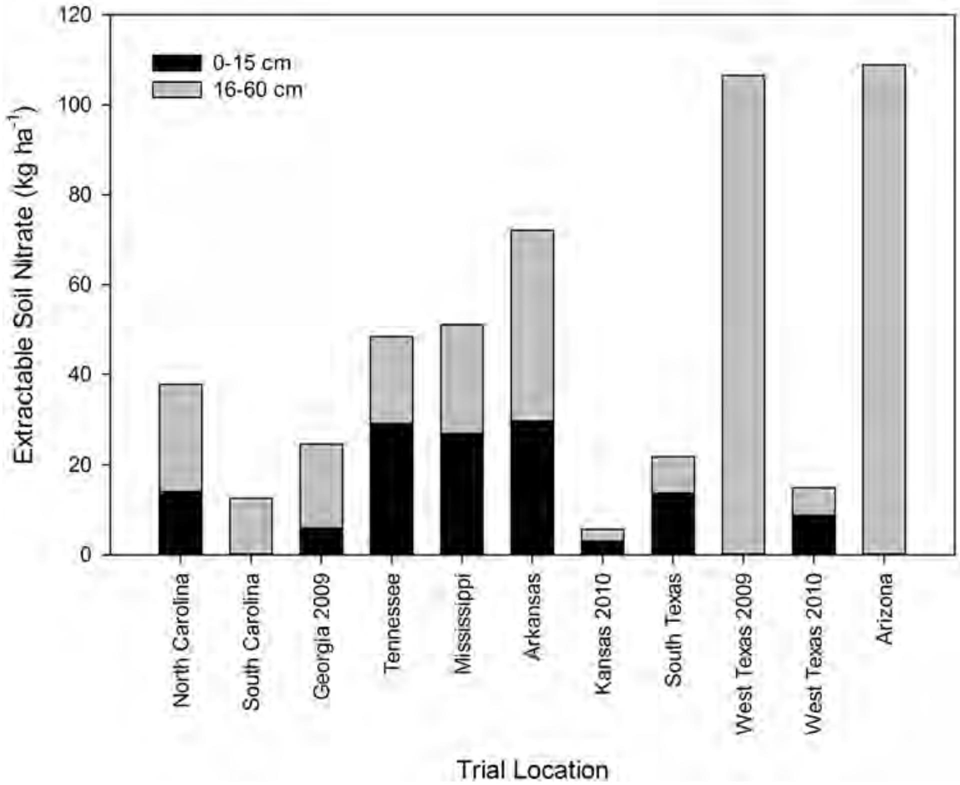

Fig. 1. Pre-plant residual soil NO_3^- by location as measured by pre-sidedress nitrate testing.

combination was considered an environment. Environments, replications nested within environment, and all interactions of these effects were considered random effects; whereas N and variety treatments were considered fixed effects. Considering environments as a random effect permits inferences about the treatments to be made over a range of environments (Blouin et al., 2011; Carmer et al.,1989). A similar statistical approach has been used by several researchers using a randomized complete block design (Bond et al., 2005; Hager et al., 2003; Jenkins et al., 1990) as well as those using a factorial arrangement of treatments in a randomized complete block design (Bond et al., 2008; Ottis et al., 2004; Walker et al., 2008). Means were separated using Fishers Protected LSD test at the 0.05 significance level.

RESULTS

Soil Nitrate Measurements

Results from analysis of soil nitrate varied based on soil type and N use history (Fig. 1). Sandy loam soils in Georgia, North Carolina, and South Carolina with previous N use contained from 17 to 22 kg NO_3^- ha^{-1} in the upper 15 cm of the soil profile with an additional 7 to 12 kg NO_3^- ha^{-1} from 16- to 60-cm depth in the soil profile. In Arkansas, Mississippi, and Tennessee there was 30 to 35 and 30 to 48 kg NO_3^- ha^{-1} in the top 15-cm and 16- to 60-cm soil depths, respectively. In areas with little to no N use history (Kansas 2010, south Texas, and west Texas 2010) total nitrate found in a 60-cm profile was <20 kg NO_3^- ha^{-1}. More arid environments with N use history (Arizona and west Texas 2009) had >130 kg NO_3^- ha^{-1} in the 60-cm profile. Pre-sidedress soil nitrate tests have shown promise in predicting N fertilizer needs for other crops. Spellman et al. (1996) reported that critical levels for PSNT NO_3^- in corn production were lower in semiarid areas of the western United States than in more humid environments and the same may be true for cotton production. Similar results were reported in Australia where soil NO_3^- levels sampled to a depth of 30 cm before planting were closely correlated to cotton N uptake in plots that received no applied N fertilizer (Constable and Rochester, 1988). While soil NO_3^- testing is not currently used to a great extent for cotton production, this type of testing could prove to be economically beneficial in areas where residual NO_3^- is present.

Effects of Seed Size × Nitrogen Rates

Contrary to the hypothesis of this research, no interaction of seed size and N rate was found (data not shown). The 60 site-year × variety means generated by this research represented a total of 18 varieties. All varieties were locally adapted and many were in the top 10 most commonly-planted varieties for the years when the experiments were conducted. Since no interactions of N rate and varieties was found, the data are presented as the main effects of seed size and N rate.

Effects of Seed Sizes

When grown in these environments with four N application levels the varieties of the respective seed-size classes produced fuzzy seed that differed in mean weight (Table 2). Lint yields and mean seed size of commercial cotton varieties have varied inversely for the past 60 yr (Culp and Harrell, 1975; Harrell and Culp, 1976; Bednarz et al., 2007), apparently in response to selection for high lint percentage and lint yield. Highest lint yields were observed in these experiments when varieties were of a medium seed size. (Table 2).

Table 2. Response of cotton lint yield, fuzzy seed size, and fiber quality parameters based on applied N rate and planting seed size.

Nitrogen	Seed size	Lint	Seed wt.	GTO†	Mic	Length	Strength	uni
kg ha^{-1}		kg ha^{-1}	g 100 seed^{-1}	%		cm	g tex^{-1}	%
0		1208	9.08	38.6	4.7	2.84	28.8	81.8
45		1368	9.27	38.3	4.6	2.82	29.0	81.9
90		1435	9.30	38.1	4.6	2.84	29.2	82.0
134		1447	9.37	37.6	4.5	2.84	29.3	82.2
LSD (0.05)		64	0.19	0.4	0.1	0.03	0.3	ns
	<9700	1327	9.65	37.9	4.5	2.87	29.4	82.3
	9701–11,000	1410	9.33	38.7	4.7	2.82	28.5	82.3
	>11,001	1357	8.80	38.5	4.6	2.84	28.9	81.8
	LSD (0.05)	55	0.16	0.3	0.1	0.03	0.3	0.2

† GTO = gin turnout; Mic = measure of fiber fineness, uni = fiber length uniformity index; tex = linear mass density of fibers, grams per 1000 meters.

Effects of Nitrogen Rates

In 11 of 20 environments there was a lint yield response to applied N. When 45 kg N ha^{-1} was applied yields were greater than when no N was applied, but were less than yields where 90 to 134 kg N ha^{-1} was applied (Fig. 2a). When all trial sites, both N responsive and non-responsive, are considered 45 kg N ha^{-1} increased yields above no applied N, but additional N above 45 kg N ha^{-1} did not improve lint yield.

Effects of Applied Nitrogen Rate Plus Soil Residual Nitrate

Cotton responds to ammonium and NO_3^-–N from all sources, soil, water, and atmospheric deposition. While any measurement of soil NO_3^- is transient, measurement of pre-plant soil NO_3^- is a relatively simple and inexpensive way for a grower to estimate readily available soil N at planting (Hons et al., 2004). Accordingly, soil NO_3^- was measured at all sites. When applied N plus measured soil NO_3^- is considered with cotton lint response a more accurate relationship may be established. To make this comparison soil NO_3^- in the upper 60 cm of the soil profile plus

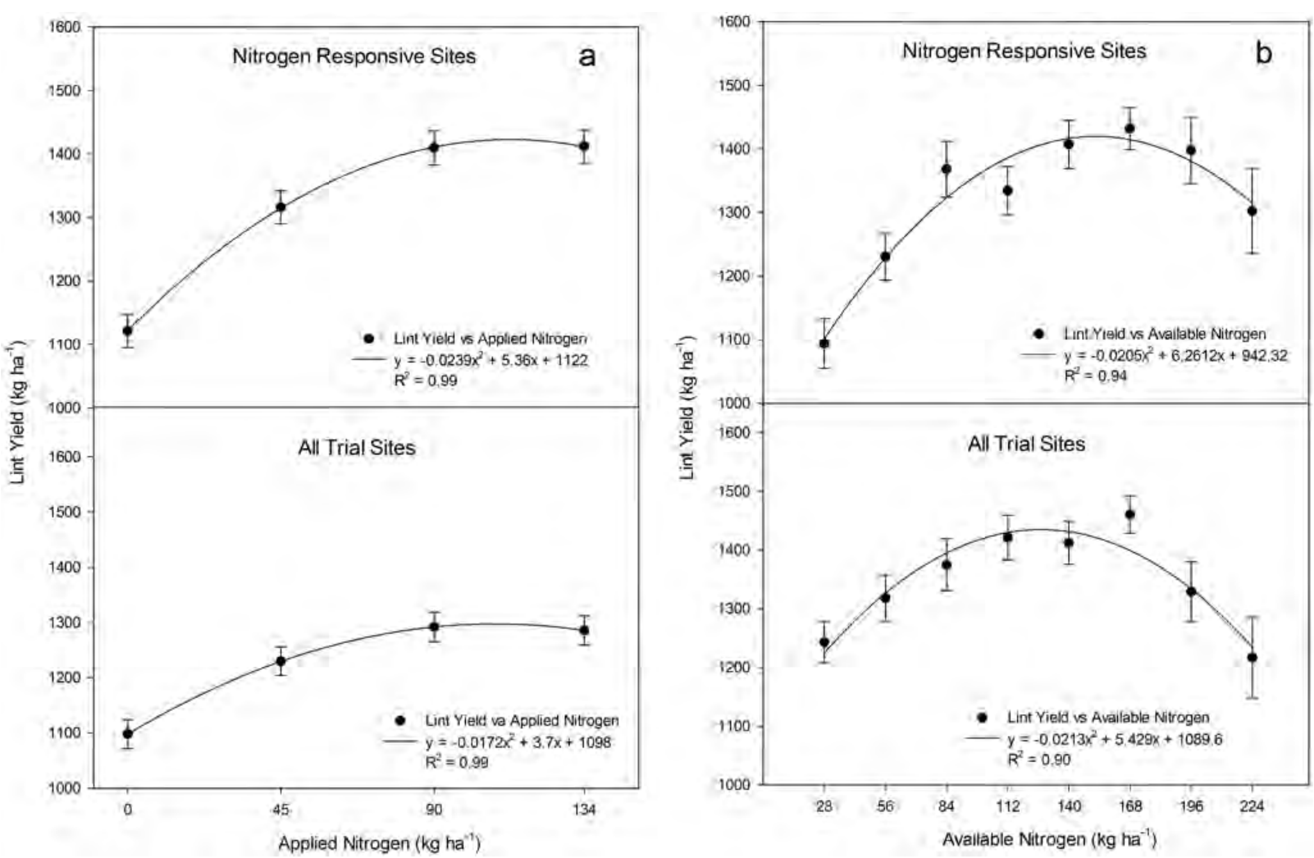

Fig. 2. (a) Response of cotton lint yield averaged over all test environments and only those environments that responded to applied N. (b) Response of cotton lint yield averaged over all test environments and only those environments that responded to applied N and applied N plus measured pre-plant soil NO_3^-.

Table 3. Cotton plant height, number of plant nodes, and relative maturity response to applied N.

Nitrogen	Plant height	Plant nodes	NACB†
kg ha^{-1}	cm	no.	
0	74.2	16.6	4.3
45	79.8	17.1	4.9
90	84.1	18.0	5.3
134	88.2	18.5	5.9
LSD (0.05)	2.3	1.0	0.5

† Node number above highest first position cracked boll to highest harvestable first position boll.

applied N was categorized into 28 kg NO_3^- ha^{-1} groups and analyzed for yield response (Fig. 2b).

Cotton Growth

Measurements of cotton plant growth and development indicate that N application rate effected plant height, total number of nodes, and delayed crop maturity. Plant height ranges from 74.2 to 88.2 cm from 0 to 134 kg ha^{-1} N application, respectively (Table 3). Similarly, the number of nodes increased with increasing N application growing an additional 1.9 nodes when comparing 134 kg ha^{-1} N application to 0 kg ha^{-1}. The consequence of growing a taller plant with more nodes is extending the length of growing season needed to mature developing bolls. The addition of N delayed cotton maturity when NAWF was measured during the second week of bloom in these trials (data not shown). Additionally, higher levels of N fertilization delayed maturity at the end of the growing season (Table 2). There was a 1.6 NACB difference which would require 88 additional heat units, or approximately 5 d based on reports of Brecke et al. (2001).

Lint Yields

Lint yields are presented as functions of applied N (Fig. 2a) and as applied N plus measured soil NO_3^- (Fig. 2b). Lint yields are shown separately for all test sites and for only those sites that had a significant response to applied N. Only 11 of the 20 environments responded to applied N. For all four cases, second degree polynomial regression was highly significant ($P < 0.01$). For both applied N and applied plus measured soil NO_3^-, the coefficient of determination was increased when only N responding sites were considered for both applied N plus measured soil NO_3^-. For N responding sites and all trial sites, a declining trend in lint yields was found when applied N plus soil NO_3^- was >152 and 125 kg N ha^{-1}, respectively. Interestingly, when 0 kg N ha^{-1} was applied in these trials the average lint yield was 1208 kg ha^{-1} indicating that residual soil NO_3^- and other forms of soil N provide nutrition to the cotton crop. However, cotton producers would be surprised to produce >1000 kg ha^{-1} cotton lint without applying supplemental N.

For N responsive sites, optimum lint yield response occurred between 112 and 196 kg of applied N plus soil NO_3^- with negative yield trend above 196 kg N ha^{-1}. This represents 19 to 36 kg ha^{-1} use per 218 kg bale of cotton lint with a maximum regression near 23 kg applied N plus soil NO_3^- ha^{-1}. When all trial sites are considered, optimum lint yield response to applied N plus soil NO_3^- shifts lower in a range from 70 to 180 kg N ha^{-1}. This represents 12 to 28 kg ha^{-1} N use per 218 kg bale of cotton lint with a regression maximum near 19 kg applied N ha^{-1}. The difference in N utilization between responsive and non-responsive locations as well as the different conclusion for optimal N rate between applied N and applied N plus soil NO_3^- illustrates just a portion of the complexity in prescribing N rates. These data suggest that soil NO_3^- testing immediately before cotton planting can serve as a guide to help prevent overfertilization and yield loss, as well as protect water resources from N loading with excessive N applications.

In Fig. 3 yield data is presented by soil type for N responsive locations and similar second degree polynomial regression indicted good to excellent response to applied N plus soil NO_3^- based on coefficients of determination. Lint yield values were normalized to percentage of the highest yielding applied N plus soil NO_3^- category. Lint yield at locations with clay loam (36% increase) and loam (75% increase) soil types responded more to applied N. Lint yield from sites with sandy loam, silt loam, and silty clay loam soil responded to applied N plus soil NO_3^- levels however, the response ranged from a16 to 22% increase.

Seed and Fiber Properties

Significant effects of N application rate on mean fuzzy seed weights, gin turnout, fiber strength, fiber length uniformity, and micronaire were found (Table 2). Increasing N rates increased mean fuzzy seed weight compared to the 0 kg N ha^{-1} rate. Although such an effect is familiar to many cotton researchers, these are the first data of which we are aware that definitely establish this relationship over multiple environments. Algebraically, an increase in mean seed weight would be expected to decrease lint percentage, and such a result was confirmed when applying 90 or 134 kg ha^{-1} N decreased gin turnout. Plant vigor associated with good N management may be expected to positively influence fiber strength and an increase in strength was found when N was applied. Similarly fiber length uniformity also increased with increasing N rate. However, fiber micronaire decreased. Micronaire is an indirect measure influenced both by fiber fineness and fiber maturity, the latter being the degree of deposition of cellulose in the secondary cell wall inside the microfibril encasing the fiber lumen (DeLanghe, 1986). In this instance, we propose that the decrease is primarily due to the decrease in fiber maturity associated with the increase in late-season growth caused by abundant N nutrition (Boman and Westerman, 1994). Small differences in fiber properties were detected for the differing planting seed sizes. However, these differences are likely due to genetic differences among varieties rather than seed size.

As anticipated, higher applied N rates increased seed protein, but the effect was small. Conversely as seed protein increased, seed oil content decreased (Fig. 4). Similar effects were observed when data was analyzed for applied N plus soil NO_3^- (data not shown). No differences were noted for seed protein or seed oil content for varieties of different seed sizes. This indicates that while seed protein and seed oil content can be affected by N application, the concentrations remain relative to seed mass.

DISCUSSION

Residual soil NO_3^- is present in Cotton Belt soils. When N is applied cotton plants grow taller, develop more nodes, and the time to crop maturity was increased in these trials. Cotton planting seed size did not interact with applied N rates.

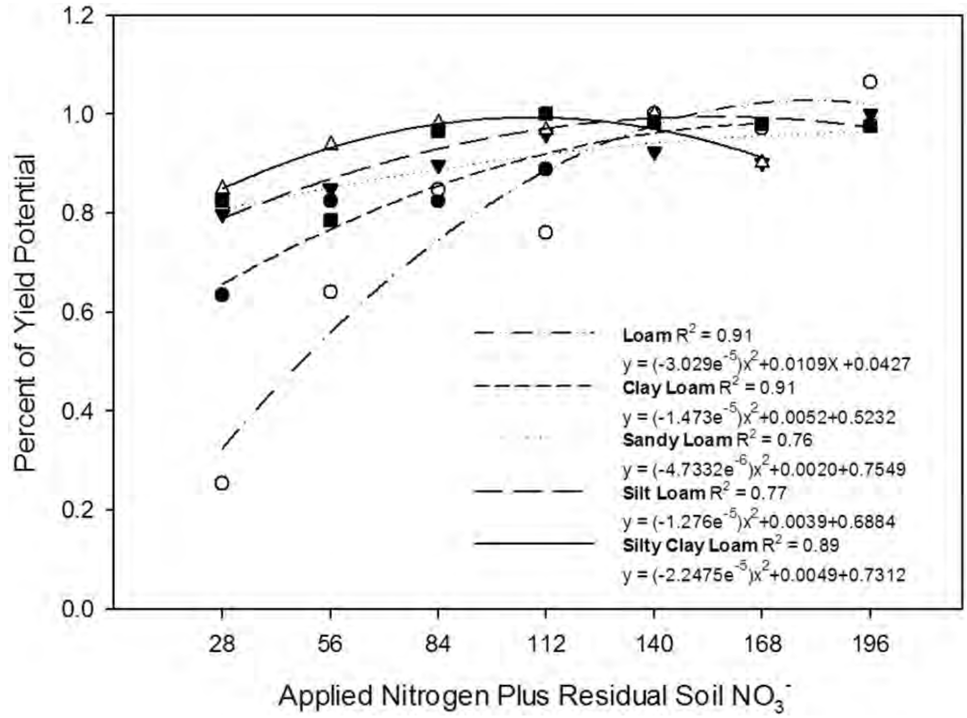

Fig. 3. Cotton lint yield response to applied N plus residual soil NO_3^- by soil type normalized to highest yielding treatment.

Increasing applied N rate increased seed index, fiber length, fiber length uniformity, fiber strength while lint percentage and fiber micronaire decreased.

Cotton lint yield responded to applied N in 11 of 20 environments included in this data set. Lint yield was increased at responsive locations by 45 kg N ha^{-1} compared to plots receiving 0 kg N ha^{-1}. Similarly applications of 90 and 134 kg N ha^{-1} increased lint yield compared to the response with 45 kg N ha^{-1}. When applied N plus residual soil NO_3^- are considered, locations that had a response to applied N maximized lint production near 150 kg applied N plus soil NO_3^- ha^{-1}. This response translates to an N requirement of 23 kg ha^{-1} for each 218 kg bale of lint produced. This research indicates that measuring soil residual NO_3^- could help reduce N input costs and reduce N loading in the environment while maintaining high levels of productivity.

While the data cannot be extrapolated to every cotton variety, we conclude that these data are sufficient to make an N recommendation of 23 kg N ha^{-1} per bale of expected yield

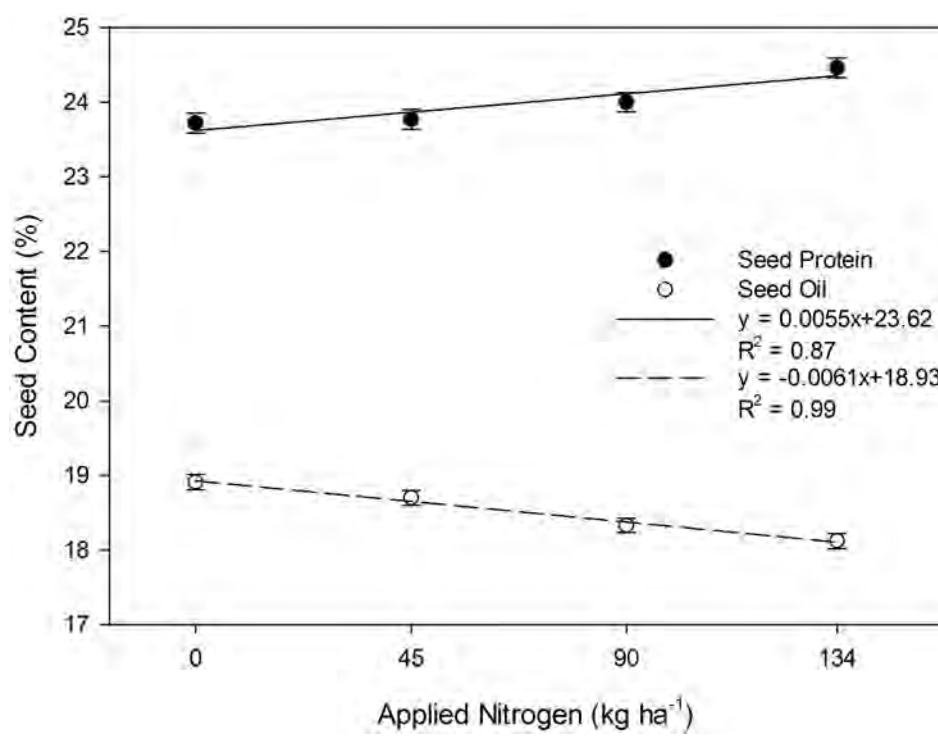

Fig. 4. Response of cottonseed protein and oil concentration to applied N.

including applied N plus residual soil NO_3^- measurements immediately before planting. This recommendation should be sufficient for contemporary cotton varieties in the absence of other data to the contrary for an individual variety. Future research should focus on N utilization efficiency of varying *Gossypium* genetics to identify germplasm that may lead to reduced N application and maintain lint yield potential.

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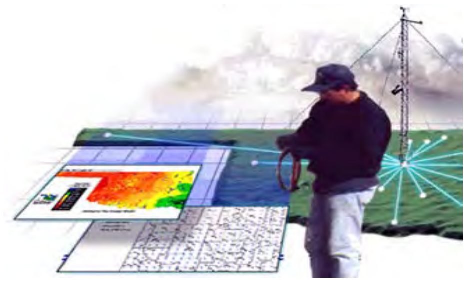
Appendix

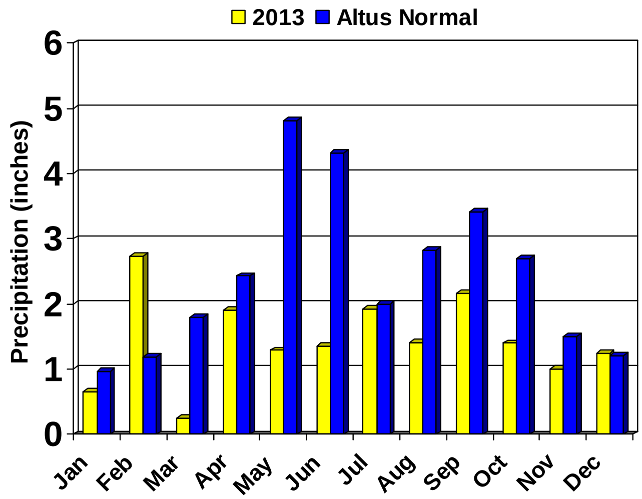


About the Mesonet The Oklahoma Mesonet is a world-class network of environmental monitoring stations. The network was designed and implemented by scientists at the University of Oklahoma (OU) and at Oklahoma State University (OSU). The Oklahoma Mesonet consists of 120 automated stations covering Oklahoma. There is at least one Mesonet station in each of Oklahoma's 77 counties. At each site, the environment is measured by a set of instruments located on or near a 10-meter-tall tower. The measurements are packaged into "observations" every 5 minutes, then the observations are transmitted to a central facility every 5 minutes, 24 hours per day year-round. The Oklahoma Climatological Survey (OCS) at OU receives the observations, verifies the quality of the data and provides the data to Mesonet customers. It only takes 5 to 10 minutes from the time the measurements are acquired until they become available to the public.

History of the Mesonet In 1982, Oklahoma scientists recognized the need for a statewide monitoring network. At OSU, agricultural scientists wanted to upgrade weather instruments at their research sites. Their primary goal was to expand the use of weather data in agricultural applications.Meanwhile, scientists from the OU meteorological community were helping to plan and implement a flood-warning system for Tulsa. The success of Tulsa's rain gauge network pointed to the potential for a more extensive, statewide network. OSU and OU joined forces in 1987 when they realized that one system would help both universities achieve their respective missions. The two universities approached the Governor's Office and, in December of 1990, the Oklahoma Mesonet Project was funded with $2.0 million of oil-overcharge funds available from a court settlement. Both universities contributed almost $350,000 each to bring the grand total to $2.7 million. In addition, the Oklahoma Law Enforcement Telecommunications System (OLETS) donated the use of their communications infrastructure to help move the data from the remote sites to OU. Once funding was available, the Mesonet Project progressed quickly. Committees were formed, potential station sites were located and surveyed and instruments were chosen. In late 1991, the first Mesonet towers were installed and, by the end of 1993, 108 sites were completely operational. Three more sites were added soon thereafter to supplement a U. S. Department of Agriculture network in the Little Washita River Basin. In 1996, three sites were added near Tulsa for an Oklahoma Department of Environmental Quality study of air pollution. Thus, by the fall of 1996, the total number of Oklahoma Mesonet sites was 114. Since 1996, 8 sites have relocated to other areas in the same town, 4 sites have been retired, and 10 sites have been added resulting in our current 120 station network. A 2009 National Research Council report named the Oklahoma Mesonet as the "gold standard" for statewide weather and climate networks. The Mesonet is unique in its capability to measure a large variety of environmental conditions at so many sites across an area as large as Oklahoma. In addition, these conditions are relayed to a wide variety of customers very quickly after the observations are taken.

Agriculture Agricultural applications of the Mesonet include improved insect and disease advisories, spraying recommendations, irrigation scheduling, frost protection, planting and harvesting recommendations and prescribed burn advisories. Agriculture is such a large Oklahoma industry that any increase in efficiency from more accurate environmental information can translate into several million dollars in statewide savings each year. Visit our Agweather site at: agweather.mesonet.org.

Altus Normal (1971-2000) and Mesonet 2013 Rainfall



Altus Normal From January 1 – April 30 6.37”

Altus Actual From January 1 – April 30 5.55” 87% of normal

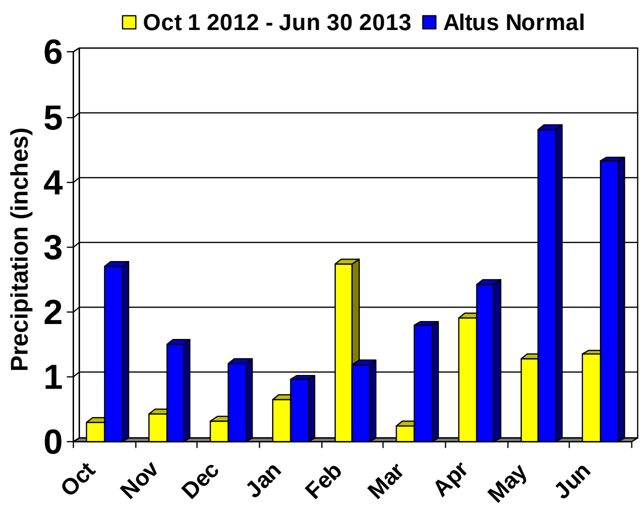
Altus Normal for year 29.16”

Altus Actual for 2013 17.34”

59.5% of Normal

Source: http://agweather.mesonet.org/index.php/data/section/climate

Altus Normal (1971-2000) and Mesonet 2012 - 2013 Rainfall



Altus Normal From October 1 – April 30 11.78”

Altus Actual From October 1 – April 30 6.60” 56% of normal

Altus Normal From October 1 – June 30 20.91”

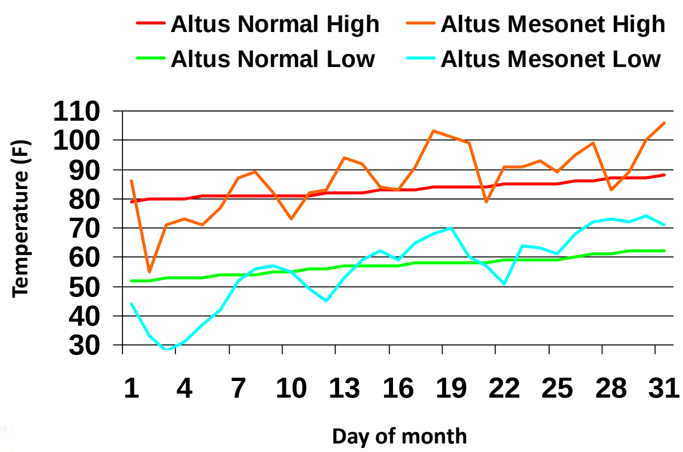
Altus Actual From October 1 – June 30 9.24” 44% of normal

Altus Normal From April 1 – June 30 11.56”

Altus Actual From April 1 – June 30 4.55” 39% of normal

Source: http://agweather.mesonet.org/index.php/data/section/climate

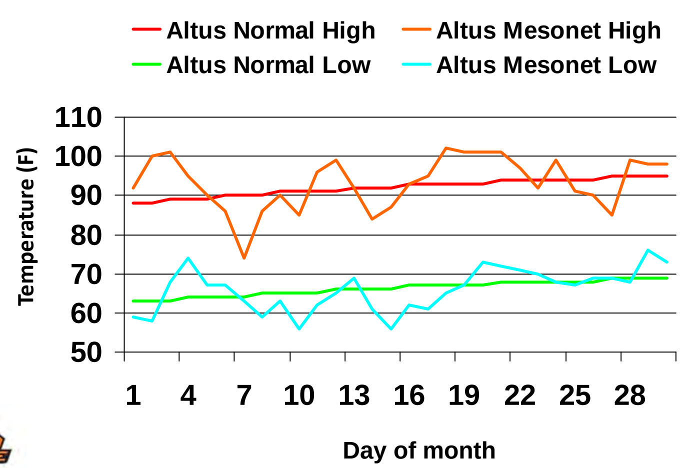
Altus
Normal (1971-2000) and Mesonet
Air Temperatures
May 2013



Heat Units

Normal: 314
2013: 402
% of normal: +28

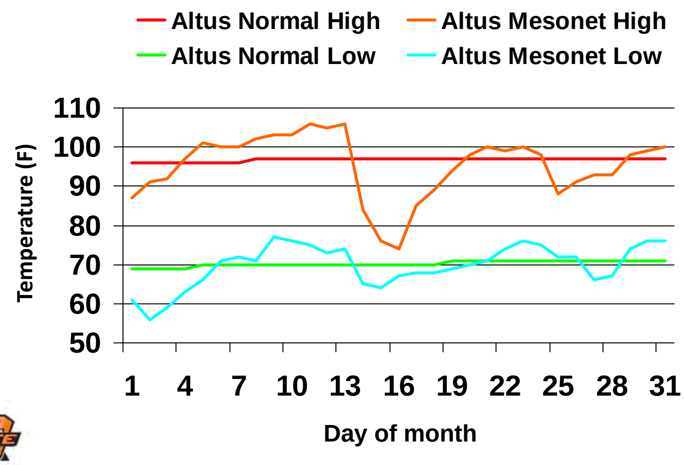
Altus
Normal (1971-2000) and Mesonet
Air Temperatures
June 2013



Heat Units

Normal: 575
2013: 675
% of normal: +17

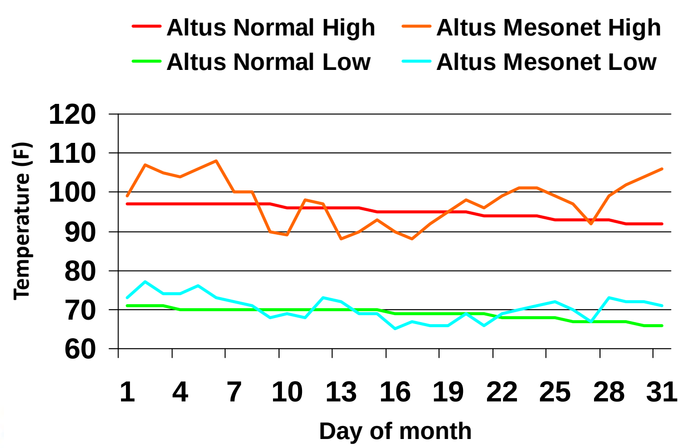
Altus
Normal (1971-2000) and Mesonet
Air Temperatures
July 2013



Heat Units

Normal: 730
2013: 698
% of normal: - 4

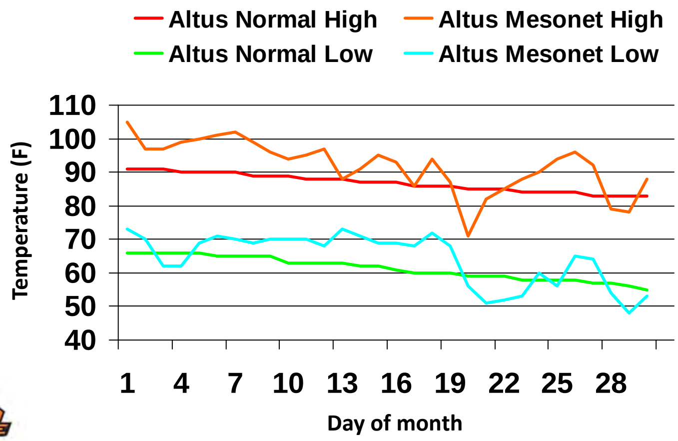
Altus
Normal (1971-2000) and Mesonet
Air Temperatures
August 2013



Heat Units

Normal: 683
2013: 749
% of normal: +10

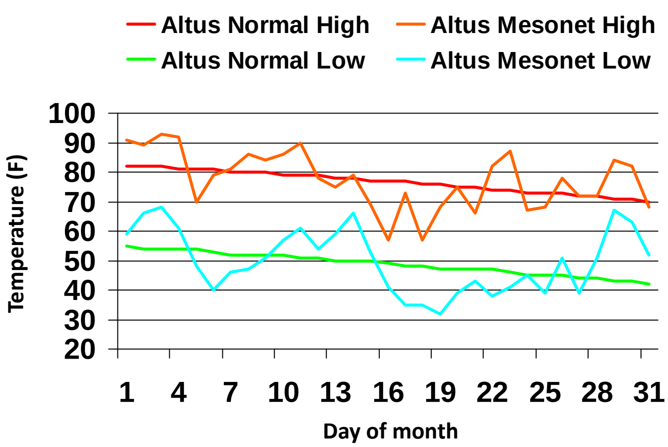
Altus
Normal (1971-2000) and Mesonet
Air Temperatures
September 2013



Heat Units

Normal: 424
2013: 543
% of normal: +28

Altus
Normal (1971-2000) and Mesonet
Air Temperatures
October 2013

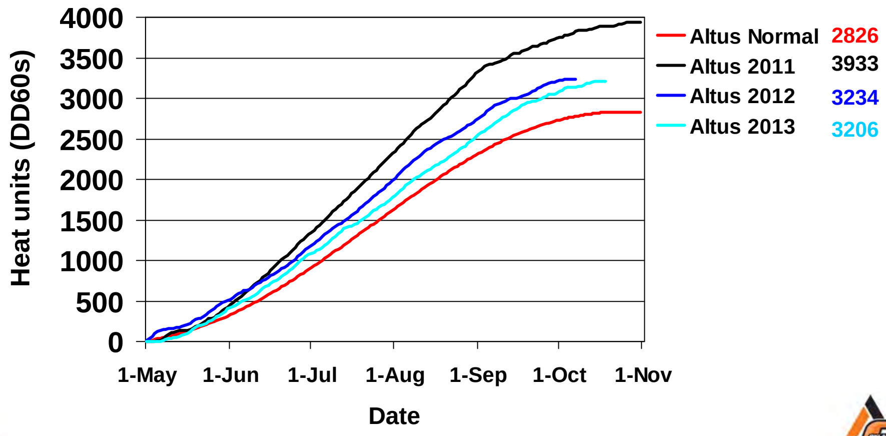


Heat Units

Normal: 102
2013: 179

% of normal: +76

Altus
30-Yr Normal, 2011, 2012, and 2013
Cotton Heat Unit Accumulation



MESONET CLIMATOLOGICAL DATA SUMMARY   May   2013   Time Zone: Midnight-Midnight CST
(FTCB) Fort Cobb   Nearest City: 4.0 NNW Fort Cobb   County: Caddo
Latitude: 35-08-55   Longitude: 98-27-57   Elevation: 1385 feet

DAY	TEMPERATURE (F) MAX	MIN	AVG	DEWPT	DEG DAYS HDD	CDD	HUMIDITY (%) MAX	MIN	AVG	RAIN (in)	PRESSURE (in) STN	MSL	WIND SPEED (mph) DIR	AVG	MAX	SOLAR (MJ/m2)	4" SOIL TEMPERATURES SOD	BARE	MAX	MIN
1	81	43	64.3	55.9	3	0	93	52	75	0.00	28.44	29.91	SSE	16.7	39.8	17.65	NA	71.0	79	64
2	52	35	43.6	33.7	21	0	92	38	71	0.06	28.89	30.38	N	20.1	48.1	11.55	NA	56.9	64	52
3	64	31	48.4	29.9	17	0	92	22	56	0.00	28.72	30.20	NW	7.4	28.6	27.46	NA	57.7	69	47
4	66	35	51.3	30.5	14	0	89	17	53	0.00	28.54	30.01	NNW	12.2	33.2	30.00	NA	60.4	70	51
5	66	46	54.2	43.6	9	0	91	49	69	0.00	28.65	30.13	N	7.7	21.9	21.46	NA	63.4	73	56
6	74	42	59.4	47.1	7	0	97	36	68	0.00	28.61	30.08	NW	4.1	12.4	25.70	NA	66.9	77	57
7	82	51	67.6	49.4	0	2	93	29	57	0.00	28.52	29.99	SE	10.2	26.5	27.28	NA	71.3	81	62
8	87	60	71.8	55.9	0	9	90	38	60	0.00	28.40	29.86	SSE	15.2	51.7	22.20	NA	72.9	81	65
9	74	61	66.1	60.9	0	2	97	69	84	0.35	28.44	29.91	E	7.1	18.0	11.41	NA	71.1	76	67
10	70	54	62.7	55.2	3	0	97	52	78	0.00	28.58	30.06	N	8.4	23.7	20.85	NA	67.3	72	63
11	80	49	63.9	48.5	1	0	94	27	62	0.00	28.71	30.19	NNE	8.8	26.3	28.22	NA	68.6	79	59
12	78	45	63.0	40.6	3	0	92	21	50	0.00	28.72	30.20	S	8.7	24.6	27.30	NA	69.7	79	61
13	91*	51*	72.8*	45.0*	0*	6*	81*	18*	41*	0.00*	28.61*	30.08*	SSW*	11.8*	26.5*	NA	NA	73.4*	84*	63*
14	89	65	77.9	48.1	0	12	55	21	36	0.00	28.53	30.00	SW	14.5	30.7	29.56	NA	76.5	86	68
15	79	60	67.8	59.5	0	5	96	46	76	0.00	28.40	29.87	S	9.8	24.0	12.22	NA	74.2	80	71
16	74	59	65.6	60.5	0	2	97	65	84	0.00	28.36	29.82	ESE	6.7	18.9	15.26	NA	72.6	78	68
17	80	61	69.9	67.3	0	5	98	73	92	0.01	28.37	29.84	ESE	9.2	19.9	10.41	NA	72.5	77	69
18	95	62	76.0	67.1	0	14	97	17	77	0.77	28.31	29.77	SSE	14.9	38.4	20.73	NA	76.3	87	71
19	94	64	78.3	59.6	0	14	91	15	60	0.00	28.17	29.63	WSW	13.4	32.7	28.42	NA	73.3	79	69
20	89	67	76.9	63.7	0	13	91	26	68	0.00	28.24	29.70	S	9.2	25.3	28.96	NA	76.5	87	69
21	73	55	63.7	53.6	1	0	91	44	71	0.40	28.38	29.84	N	8.5	31.1	16.86	NA	70.4	76	66
22	83	52	67.5	54.9	0	2	96	35	68	0.00	28.42	29.89	SE	5.5	19.2	28.31	NA	70.2	78	62
23	82	62	70.1	60.4	0	7	89	47	73	0.00	28.53	30.01	E	12.1	27.7	18.42	NA	71.2	79	66
24	85	61	72.1	64.9	0	8	94	58	79	0.00	28.63	30.10	SE	12.9	28.3	17.39	NA	72.8*	80*	66*
25	81	60	70.9	63.8	0	6	94	60	79	0.00	28.61	30.08	SSE	13.1	34.9	21.58	NA	74.7	82	68
26	87	68	76.3	67.5	0	12	92	53	76	0.00	28.48	29.95	SSE	17.6	32.6	21.26	NA	77.3	85	72
27	88	71	78.3	67.6	0	14	88	53	71	0.00	28.33	29.79	S	20.6	39.2	26.30	NA	80.2	88	74
28	79	74	76.0	66.9	0	12	86	63	74	0.00	28.28	29.74	S	17.4	35.0	13.30	NA	78.3	81	76
29	81	62	72.3	65.7	0	6	98	63	80	1.59	28.22	29.68	SSE	19.2	55.0	13.42	NA	75.5	82	71
30	92	71	77.0	67.8	0	16	90	25	75	0.00	28.19	29.64	S	18.0	36.3	25.46	NA	75.1	82	71
31	95	68	80.3	68.6	0	16	87	41	69	0.00	28.20	29.66	S	16.4	40.3	26.30	NA	76.4	82	71
	80*	56*	67.9*	55.6*	<- Monthly Averages ->						28.47*	29.94*	S *	12.2*	55.0*	21.51*	NA	71.4*	79*	65*

Temperature - Highest: 95*
Lowest: 31*

Degree Days - Total HDD: 79*
Total CDD: 184*

Rainfall: Monthly Total: 3.18* in.
Greatest 24 Hr: 1.59* in.

Humidity - Highest: 98*
Lowest: 15*

Number of Days With:
Tmax ≥ 90: 5*   Rainfall ≥ 0.01 inch: 6*
Tmax ≤ 32: 0*   Rainfall ≥ 0.10 inch: 4*
Tmin ≤ 32: 1*   Avg Wind Speed ≥ 10 mph: 18*
Tmin ≤ 0: 0*   Max Wind Speed ≥ 30 mph: 15*

    * Denotes incomplete record

Monthly data generated on Wednesday, July 31, 2013 at 13:04 UTC

MESONET CLIMATOLOGICAL DATA SUMMARY — June 2013 — Time Zone: Midnight-Midnight CST

(FTCB) Fort Cobb — Nearest City: 4.0 NNW Fort Cobb — County: Caddo

Latitude: 35-08-55 — Longitude: 98-27-57 — Elevation: 1385 feet

DAY	TEMPERATURE (F) MAX	MIN	AVG	DEWPT	DEG DAYS HDD	CDD	HUMIDITY (%) MAX	MIN	AVG	RAIN (in)	PRESSURE (in) STN	MSL	WIND SPEED (mph) DIR	AVG	MAX	SOLAR (MJ/m2)	4" SOIL TEMPERATURES SOD	BARE	MAX	MIN
1	83	61	72.6	54.2	0	7	92	27	57	0.02	28.45	29.92	N	9.7	32.8	30.08	NA	74.8	81	70
2	77	57	66.5	50.8	0	2	86	33	60	0.00	28.60	30.08	NNE	7.7	21.9	30.34	NA	75.2	86	66
3	86	57	71.0	56.6	0	6	92	38	64	0.00	28.44	29.91	SE	12.2	28.2	25.04	NA	76.1	85	68
4	88	62	75.8	65.9	0	10	97	51	73	1.03	28.38	29.84	ESE	14.7	45.9	26.84	NA	76.3	82	70
5	83	64	73.3	64.6	0	9	95	53	76	0.45	28.45	29.92	NE	11.7	46.5	20.33	NA	75.2	80	71
6	78	60	68.9	57.8	0	4	87	41	70	0.00	28.51	29.98	NNE	10.7	21.6	20.98	NA	72.0	77	69
7	81	55	69.4	54.9	0	3	94	35	64	0.00	28.52	29.99	SSE	5.2	18.3	26.22	NA	72.1	80	65
8	86	62	73.1	57.1	0	9	94	33	60	0.66	28.40	29.86	SSE	14.3	45.9	21.45	NA	NA	NA	NA
9	88	59	74.1	59.3	0	9	96	26	65	0.04	28.45	29.92	S	6.4	37.6	30.41	NA	NA	NA	NA
10	98	68	82.8	60.9	0	18	87	20	53	0.00	28.44	29.91	S	12.5	28.3	30.43	NA	NA	NA	NA
11	95	66	83.1	60.8	0	15	75	25	50	0.00	28.46	29.93	S	13.2	29.6	29.07	NA	NA	NA	NA
12	98	75	85.4	64.1	0	22	75	28	52	0.00	28.47	29.94	SSW	14.1	30.5	29.39	NA	NA	NA	NA
13	98	69	84.5	65.4	0	19	88	29	57	0.00	28.51	29.99	S	7.7	24.6	29.72	NA	NA	NA	NA
14	96	70	83.6	64.0	0	18	90	26	56	0.00	28.49	29.96	S	9.2	24.8	25.85	NA	NA	NA	NA
15	88	71	79.1	65.1	0	14	92	47	64	0.00	28.50	29.97	SE	8.8	28.0	21.30	NA	NA	NA	NA
16	95	70	78.9	68.8	0	17	97	36	75	0.21	28.48	29.95	S	9.0	32.9	24.06	NA	NA	NA	NA
17	84	65	74.9	66.0	0	10	98	51	76	2.28	28.50	29.97	ENE	8.8	38.8	28.35	NA	NA	NA	NA
18	86	66	75.5	64.1	0	11	96	44	70	0.00	28.54	30.01	ESE	5.2	18.4	27.28	NA	NA	NA	NA
19	84	66	74.5	68.2	0	10	97	58	82	0.00	28.49	29.96	SE	9.9	27.8	13.23	NA	NA	NA	NA
20	93	71	82.0	68.2	0	17	88	39	65	0.00	28.47	29.94	SSE	16.1	35.3	24.52	NA	NA	NA	NA
21	94	74	83.9	66.5	0	19	72	39	57	0.00	28.49	29.96	SSE	15.1	30.2	26.58	NA	NA	NA	NA
22	94	73	83.8	62.0	0	19	75	26	50	0.00	28.45	29.92	SSE	16.5	36.8	28.30	NA	NA	NA	NA
23	96	74	84.4	62.1	0	20	75	25	50	0.00	28.40	29.87	SSE	18.1	37.5	25.22	NA	NA	NA	NA
24	94	75	83.0	63.9	0	19	70	32	55	0.00	28.44	29.91	S	16.6	32.1	25.58	NA	NA	NA	NA
25	95	75	84.6	67.1	0	20	73	42	57	0.00	28.37	29.84	S	17.3	32.7	26.21	NA	NA	NA	NA
26	97	73	85.6	67.4	0	20	81	37	56	0.00	28.39	29.86	SSE	12.2	30.7	28.23	NA	NA	NA	NA
27	103	73	88.1	65.7	0	23	89	25	53	0.00	28.48	29.95	S	9.5	44.1	28.74	NA	NA	NA	NA
28	96	73	84.6	62.0	0	20	77	25	50	0.00	28.50	29.97	NE	8.5	26.2	29.39	NA	NA	NA	NA
29	93	71	81.0	59.9	0	17	74	28	51	0.00	28.48	29.95	NE	5.7	18.1	23.55	NA	NA	NA	NA
30	87	65	77.0	54.8	0	11	79	30	48	0.00	28.53	30.00	NE	9.2	24.3	29.56	NA	NA	NA	NA
	91	67	78.8	62.3	<- Monthly Averages ->						28.47	29.94	S	11.2	46.5	26.21	NA	74.5*	82*	68*

Temperature - Highest: 103
Lowest: 55

Degree Days - Total HDD: 0
Total CDD: 417

Rainfall: Monthly Total: 4.69 in.
Greatest 24 Hr: 2.28 in.

Humidity - Highest: 98
Lowest: 20

Number of Days With:

Tmax ≥ 90:	16	Rainfall ≥ 0.01 inch:	7
Tmax ≤ 32:	0	Rainfall ≥ 0.10 inch:	5
Tmin ≤ 32:	0	Avg Wind Speed ≥ 10 mph:	15
Tmin ≤ 0:	0	Max Wind Speed ≥ 30 mph:	16

* Denotes incomplete record

Monthly data generated on Friday, August 30, 2013 at 13:09 UTC

MESONET CLIMATOLOGICAL DATA SUMMARY   July   2013   Time Zone: Midnight-Midnight CST
(FTCB) Fort Cobb   Nearest City: 4.0 NNW Fort Cobb   County: Caddo
Latitude: 35-08-55   Longitude: 98-27-57   Elevation: 1385 feet

DAY	TEMPERATURE (F) MAX	MIN	AVG	DEWPT	DEG DAYS HDD	CDD	HUMIDITY (%) MAX	MIN	AVG	RAIN (in)	PRESSURE (in) STN	MSL	WIND SPEED (mph) DIR	AVG	MAX	SOLAR (MJ/m2)	4" SOIL TEMPERATURES SOD	BARE	MAX	MIN
1	84	60	72.1	NA	0	7	NA	NA	NA	0.00	28.62	30.10	NE	8.3	28.8	27.56	NA	NA	NA	NA
2	85	56	72.3	NA	0	6	NA	NA	NA	0.00	28.64	30.12	NW	5.2	19.0	28.98	NA	NA	NA	NA
3	88	58	74.3	50.8	0	8	87	23	49	0.00	28.57	30.04	SE	5.6	19.3	27.23	NA	NA	NA	NA
4	92	63	76.3	53.4	0	12	74	21	48	0.00	28.50	29.97	SE	8.0	21.9	20.40	NA	NA	NA	NA
5	93	66	79.1	NA	0	14	NA	NA	NA	0.00	28.46	29.93	SE	12.4	30.1	21.84	NA	NA	NA	NA
6	96	70	82.2	NA	0	18	NA	NA	NA	0.00	28.44	29.91	SSE	12.5	26.6	22.80	NA	NA	NA	NA
7	96	69	82.7	NA	0	18	NA	NA	NA	0.00	28.51	29.98	SE	10.7	24.3	25.90	NA	NA	NA	NA
8	97	69	84.2	64.6	0	18	85	30	55	0.00	28.55	30.03	SE	9.7	24.2	26.79	NA	NA	NA	NA
9	100	73	87.5	NA	0	22	NA	NA	NA	0.00	28.54	30.02	S	10.3	24.7	27.89	NA	NA	NA	NA
10	99*	72*	87.0*	NA	0*	21*	NA	NA	NA	0.00*	28.52*	29.99*	S *	8.4*	29.6*	NA	NA	NA	NA	NA
11	98	74	85.5	NA	0	21	NA	NA	NA	0.00	28.49	29.96	E	8.1	27.1	25.45	90.5	91.2	99	85
12	97	71	84.5	NA	0	19	NA	NA	NA	0.00	28.48	29.95	SE	9.4	27.7	27.19	90.6	91.6	99	85
13	99	73	86.0	NA	0	21	NA	NA	NA	0.00	28.49	29.96	SE	9.7	23.8	26.96	91.4	92.5	101	86
14	82	65	69.8	63.6	0	8	97	51	83	1.11	28.54	30.01	SE	9.3	31.8	1.88	81.5	82.4	92	75
15	75	63	67.3	64.2	0	4	97	70	90	0.42	28.61	30.09	ESE	8.8	23.7	11.48	74.7	74.3	78	72
16	82	68	72.7	68.3	0	10	97	62	87	0.13	28.71	30.19	ESE	8.9	21.9	11.01	75.4	75.1	79	72
17	85	69	75.2	69.8	0	12	96	58	84	0.19	28.77	30.26	E	5.9	34.6	17.65	77.9	77.5	84	73
18	89	68	78.0	67.9	0	13	98	41	74	0.00	28.68	30.16	S	6.8	26.0	26.31	79.4	79.2	84	74
19	93	69	81.1	66.1	0	16	93	35	64	0.00	28.54	30.01	S	7.9	21.1	25.04	79.6	79.3	84	74
20	94	70	82.7	66.9	0	17	94	33	63	0.00	28.45	29.92	SSE	9.0	20.2	25.17	80.9	82.0	91	75
21	97	70	84.9	65.1	0	19	92	27	56	0.00	28.40	29.87	S	9.9	25.5	27.83	83.4	86.0	95	78
22	97	72	85.7	67.7	0	19	85	35	58	0.00	28.42	29.89	S	11.2	27.2	27.83	85.6	88.3	97	80
23	98	74	86.9	68.6	0	21	84	35	58	0.00	28.41	29.88	S	9.6	26.1	27.88	87.7	90.4	99	83
24	93	68	80.6	67.8	0	16	89	39	67	0.00	28.51	29.98	E	9.3	39.1	26.43	88.8	90.6	99	83
25	82	71	76.6	70.6	0	12	95	66	82	0.83	28.58	30.05	SSE	7.1	24.1	9.09	84.4	86.0	90	82
26	85	70	75.8	69.3	0	12	97	54	82	3.25	28.53	30.00	NNE	12.0	34.6	19.41	77.9	79.2	83	77
27	85	66	75.9	66.7	0	11	98	49	75	0.00	28.56	30.04	SE	6.0	16.7	26.31	79.6*	79.8*	87*	73*
28	86	67	76.4	65.6	0	11	96	41	72	0.00	28.50	29.97	SSE	10.7	23.5	27.39	78.2	78.4	83	74
29	89	71	80.0	71.0	0	15	92	50	75	NA	28.46	29.93	SSE	14.1	33.0	19.82	78.2	78.1	83	74
30	91	73	81.7	69.5	0	17	90	51	68	NA	28.55	30.02	NNE	7.4	21.9	26.47	82.5	81.9	90	75
31	90	75	80.6	71.4	0	17	93	50	75	NA	28.60	30.08	NE	7.8	17.2	24.06	84.9	84.9	94	78
	91*	69*	79.5*	66.1*	<- Monthly Averages ->						28.54*	30.01*	SE *	9.0*	39.1*	23.00*	82.5*	83.3*	90*	77*

Temperature - Highest: 100*
Lowest: 56*

Degree Days - Total HDD: 0*
Total CDD: 455*

Rainfall: Monthly Total: 5.93* in.
Greatest 24 Hr: 3.25* in.

Humidity - Highest: 98*
Lowest: 21*

Number of Days With:
Tmax ≥ 90: 18*   Rainfall ≥ 0.01 inch: 6*
Tmax ≤ 32: 0*   Rainfall ≥ 0.10 inch: 6*
Tmin ≤ 32: 0*   Avg Wind Speed ≥ 10 mph: 8*
Tmin ≤ 0: 0*   Max Wind Speed ≥ 30 mph: 6*

* Denotes incomplete record

Monthly data generated on Monday, September 30, 2013 at 12:04 UTC

MESONET CLIMATOLOGICAL DATA SUMMARY August 2013 Time Zone: Midnight-Midnight CST
(FTCB) Fort Cobb Nearest City: 4.0 NNW Fort Cobb County: Caddo
Latitude: 35-08-55 Longitude: 98-27-57 Elevation: 1385 feet

DAY	TEMPERATURE (F) MAX	MIN	AVG	DEWPT	DEG DAYS HDD	CDD	HUMIDITY (%) MAX	MIN	AVG	RAIN (in)	PRESSURE (in) STN	MSL	WIND SPEED (mph) DIR	AVG	MAX	SOLAR (MJ/m2)	4" SOIL TEMPERATURES SOD	BARE	MAX	MIN
1	91	72	80.8	69.9	0	17	90	41	71	NA	28.57	30.05	SE	6.8	19.4	26.09	86.4	87.3	97	79
2	101	74	87.5	67.1	0	23	91	27	56	NA	28.41	29.88	SSE	11.1	24.6	26.67	87.9	89.3	98	82
3	98	73	86.3	65.4	0	21	76	32	52	NA	28.48	29.95	S	10.8	24.1	26.37	88.7	90.5	99	83
4	97	73	83.7	67.3	0	20	83	31	60	NA	28.52	29.99	SSE	10.1	23.7	24.43	88.5	90.2	98	83
5	99	75	86.8	65.9	0	22	79	29	53	NA	28.44	29.91	S	10.0	24.4	27.00	89.6	91.4	100	84
6	99	73	87.1	63.0	0	21	72	27	47	NA	28.36	29.83	SSE	11.6	25.5	27.58	89.9	91.7	99	85
7	90	71	82.0	NA	0	16	NA	NA	NA	NA	28.39	29.85	ENE	6.6	20.6	14.47	87.6	89.0	94	85
8	89	69	76.9	69.4	0	14	93	52	79	NA	28.42	29.89	ESE	8.0	29.8	19.18	82.9	83.5	89	79
9	85	68	76.0	69.0	0	12	95	59	80	NA	28.53	30.00	NNE	6.6	20.4	20.83	81.9	81.3	87	77
10	84	67	74.1	66.0	0	10	92	53	77	NA	28.66	30.13	NNE	7.1	19.1	23.39	80.6	80.3	88	74
11	91	66	78.4	68.7	0	13	96	46	75	NA	28.61	30.08	ESE	4.1	16.1	25.40	83.2	84.4	95	75
12	93	70	79.0	70.0	0	16	93	47	75	NA	28.54	30.02	SW	6.5	34.6	18.28	82.9	83.1	89	79
13	83	71	75.7	70.4	0	12	97	61	84	NA	28.56	30.04	N	6.7	21.0	15.70	80.2	80.1	85	76
14	83	68	74.5	66.3	0	10	95	53	77	NA	28.61	30.08	NE	7.2	16.8	23.29	80.2	79.5	85	74
15	84	66	72.4	66.4	0	10	95	60	82	NA	28.57	30.05	SSE	6.9	19.5	20.44	78.4	78.0	84	74
16	83	63	72.1	64.6	0	8	95	59	79	NA	28.60	30.07	E	5.8	31.8	25.56	78.7	78.1	85	72
17	81	63	72.0	63.7	0	7	96	54	77	NA	28.63	30.10	ESE	5.9	15.7	21.64	78.0	77.7	85	72
18	85	65	73.8	NA	0	10	NA	NA	NA	NA	28.61	30.09	ESE	7.6	19.3	22.79	78.5	79.4	88	73
19	88	64	75.7	64.0*	0	11	93*	42*	68*	NA	28.57	30.04	SSE	8.7	24.1	24.23	79.4	81.3	90	74
20	91	65	77.3	63.5	0	13	90	37	66	NA	28.55	30.02	ESE	8.1	19.7	24.79	80.6	83.1	92	75
21	89*	63*	76.6*	62.7*	0*	11*	89*	38*	65*	NA	28.58*	30.05*	ESE*	6.4*	21.3*	NA	81.4*	84.1*	92*	76*
22	92	66	79.1	66.8	0	14	90	41	68	0.00	28.57	30.04	ESE	6.7	22.0	23.28	82.5	85.4	94	78
23	94	69	80.9	68.1	0	16	94	34	68	0.00	28.54	30.02	SE	7.8	21.6	24.96	84.1	87.4	96	80
24	93	69	80.7	68.2	0	16	93	39	69	0.00	28.59	30.07	ESE	6.7	18.3	23.80	84.8	88.3	97	81
25	92	70	80.7	68.2	0	16	95	43	69	0.00	28.67	30.14	ESE	7.5	19.2	22.99	85.0	88.5	96	82
26	91	68	79.1	NA	0	14	NA	NA	NA	0.00	28.67	30.15	SE	7.2	20.5	24.52	84.7	88.2	96	82
27	87	64	75.8	67.2*	0	10	92*	54*	75*	0.00	28.61	30.08	SSE	7.5	20.5	20.81	83.5	86.6	93	81
28	93	69	79.6	67.3	0	16	95	39	69	0.00	28.57	30.04	S	8.3	24.9	21.72	85.1	86.3	93	81
29	95	67	81.4	63.7	0	16	88	30	58	0.00	28.56	30.04	S	6.4	24.9	22.66	86.2	87.3	94	82
30	99	68	83.2	63.1	0	19	89	28	55	0.00	28.49	29.96	SSE	6.5	21.3	23.68	87.1	88.1	95	82
31	101	69	84.8	61.3	0	20	78	21	49	0.00	28.40	29.87	SSE	6.0	17.3	23.73	88.1	88.9	96	83
	91*	68*	79.2*	66.3*	<- Monthly Averages ->						28.54*	30.02*	ESE*	7.5*	34.6*	23.01*	83.8*	85.1*	92*	79*

Temperature - Highest: 101*
Lowest: 63*

Degree Days - Total HDD: 0*
Total CDD: 455*

Rainfall: Monthly Total: 0.00* in.
Greatest 24 Hr: 0.00* in.

Humidity - Highest: 97*
Lowest: 21*

Number of Days With:
Tmax ≥ 90: 19* Rainfall ≥ 0.01 inch: 0*
Tmax ≤ 32: 0* Rainfall ≥ 0.10 inch: 0*
Tmin ≤ 32: 0* Avg Wind Speed ≥ 10 mph: 5*
Tmin ≤ 0: 0* Max Wind Speed ≥ 30 mph: 2*

* Denotes incomplete record

Monthly data generated on Thursday, October 31, 2013 at 12:19 UTC

MESONET CLIMATOLOGICAL DATA SUMMARY | September 2013 | Time Zone: Midnight-Midnight CST
(FTCB) Fort Cobb | Nearest City: 4.0 NNW Fort Cobb | County: Caddo
Latitude: 35-08-55 | Longitude: 98-27-57 | Elevation: 1385 feet

DAY	TEMPERATURE (F) MAX	MIN	AVG	DEWPT	DEG DAYS HDD	CDD	HUMIDITY (%) MAX	MIN	AVG	RAIN (in)	PRESSURE (in) STN	MSL	WIND SPEED (mph) DIR	AVG	MAX	SOLAR (MJ/m2)	4" SOIL TEMPERATURES SOD	BARE	MAX	MIN
1	95	69	80.5	NA	0	17	NA	NA	NA	0.00	28.43	29.90	NNE	6.8	24.9	14.68	86.3	87.2	90	84
2	90	66	77.9	62.1	0	13	94	29	63	0.00	28.54	30.01	NE	6.6	18.1	24.46	86.5	86.9	93	82
3	90	59	74.6	57.8	0	10	94	27	60	0.00	28.58	30.05	E	4.3	14.4	25.04	85.5	85.9	93	80
4	92	58	76.4	NA	0	10	NA	NA	NA	0.00	28.61	30.08	ESE	5.0	17.9	24.60	85.3	85.6	93	79
5	94*	66*	79.5*	NA	0*	15*	NA	NA	NA	0.00*	28.63*	30.11*	ESE*	5.8*	15.1*	21.85*	86.5*	86.5*	93*	81*
6	97	67	81.3	62.7	0	17	86	26	57	0.00	28.58	30.06	ESE	5.8	20.0	21.24	87.0	87.3	95	81
7	99	68	82.4	62.2	0	18	85	25	56	0.00	28.52	29.99	SE	5.7	22.9	22.45	87.6	88.5	96	82
8	96	67	81.5	NA	0	16	NA	NA	NA	0.00	28.49	29.96	SSE	7.5	23.4	23.22	87.3	88.2	95	82
9	93	67	80.5	59.4	0	15	84	25	53	0.00	28.49	29.96	SSE	10.0	28.3	23.56	86.3	87.1	93	81
10	91	67	79.3	62.3	0	14	88	35	58	0.00	28.58	30.05	SSE	9.8	27.9	20.58	85.6	86.3	92	81
11	92	66	79.3	61.1	0	14	81	32	57	0.00	28.63	30.10	SSE	6.5	22.7	21.83	85.7	86.4	93	80
12	94	66	79.2	62.9	0	15	88	30	61	0.00	28.60	30.07	E	5.1	20.8	20.91	86.4	87.0	95	81
13	84	70	76.4	66.3	0	12	91	53	72	0.00	28.55	30.03	ENE	8.9	25.4	18.43	85.4	85.9	91	82
14	85	64	73.8	61.0	0	10	87	48	65	0.02	28.51	29.98	E	7.0	15.8	13.73	82.6	83.1	87	80
15	94	68	80.5	61.4	0	16	82	31	55	0.00	28.53	30.00	SE	8.0	25.2	17.47	83.3	83.7	90	78
16	89	69	75.8	67.2	0	14	96	44	77	0.09	28.63	30.11	E	7.6	27.5	16.47	83.7	84.2	90	80
17	87	70	74.6	68.8	0	13	99	49	84	0.31	28.57	30.05	SSE	6.7	29.9	11.33	79.7	80.0	84	77
18	92	68	79.6	64.2	0	15	93	31	63	0.00	28.47	29.94	SSE	10.9	32.0	20.45	79.7	80.6	87	75
19	85	69	75.5	65.6	0	12	93	53	72	0.00	28.47	29.94	SSW	8.7	22.8	10.09	78.0	79.1	82	76
20	70	53	65.9	59.3	3	0	97	58	80	0.00	28.54	30.01	NNE	10.8	25.1	6.81	74.0	75.0	78	71
21	82	51	65.2	49.4*	0	1	97*	27*	62*	0.00	28.53	30.01	NW	5.1	15.6	22.78	74.2	74.5	84	67
22	84	50	67.1	NA	0	2	NA	NA	NA	0.00	28.42	29.89	SSE	7.1	20.1	22.87	75.0	75.5	84	68
23	85	50	68.7	49.6	0	3	92	25	56	0.00	28.35	29.81	S	10.7	31.1	22.05	74.7	75.2	82	69
24	88	55	70.4	NA	0	6	NA	NA	NA	0.00	28.48	29.95	NW	6.5	23.1	22.35	75.8	76.2	83	70
25	92	49	71.4	NA	0	6	NA	NA	NA	0.00	28.38	29.85	SE	7.7	22.4	21.95	76.2	76.5	85	69
26	95	63	79.7	53.5	0	14	73	23	43	0.00	28.34	29.81	SSE	15.6	36.8	21.08	78.6	78.7	85	73
27	89	62	77.1	62.1	0	11	83	42	61	0.00	28.39	29.85	SSE	15.8	34.6	15.48	78.2	78.4	83	73
28	78	53	66.3	56.4	0	0	97	41	72	1.59	28.53	30.00	N	12.2	30.2	14.75	72.3	72.8	79	66
29	76	48	61.4	47.7	3	0	95	27	66	0.00	28.57	30.05	NW	3.9	11.4	21.86	68.5	67.5	75	60
30	84	49	66.2	51.4	0	1	95	32	63	0.00	28.39	29.86	SSE	9.6	24.9	21.35	67.4	66.5	73	61
	89*	62*	74.9*	59.8*	<- Monthly Averages ->						28.51*	29.98*	SSE*	8.0*	36.8*	19.52*	80.8*	81.2*	87*	76*

Temperature - Highest: 99*
Lowest: 48*

Degree Days - Total HDD: 6*
Total CDD: 311*

Rainfall: Monthly Total: 2.01* in.
Greatest 24 Hr: 1.59* in.

Humidity - Highest: 99*
Lowest: 23*

Number of Days With:
Tmax ≥ 90: 16* | Rainfall ≥ 0.01 inch: 4*
Tmax ≤ 32: 0* | Rainfall ≥ 0.10 inch: 2*
Tmin ≤ 32: 0* | Avg Wind Speed ≥ 10 mph: 7*
Tmin ≤ 0: 0* | Max Wind Speed ≥ 30 mph: 5*

* Denotes incomplete record

Monthly data generated on Tuesday, December 10, 2013 at 19:29 UTC

MESONET CLIMATOLOGICAL DATA SUMMARY — October 2013 — Time Zone: Midnight-Midnight CST
(FTCB) Fort Cobb — Nearest City: 4.0 NNW Fort Cobb — County: Caddo
Latitude: 35-08-55 — Longitude: 98-27-57 — Elevation: 1385 feet

DAY	TEMPERATURE (F) MAX	MIN	AVG	DEWPT	DEG DAYS HDD	CDD	HUMIDITY (%) MAX	MIN	AVG	RAIN (in)	PRESSURE (in) STN	MSL	WIND SPEED (mph) DIR	AVG	MAX	SOLAR (MJ/m2)	4" SOIL TEMPERATURES SOD	BARE	MAX	MIN
1	89	58	72.1	58.3	0	9	89	33	65	0.00	28.41	29.88	SSE	12.9	28.5	20.48	68.7	67.9	74	62
2	87	63	73.5	65.8	0	10	99	52	79	0.00	28.43	29.90	SSE	12.8	28.0	12.83	70.7	70.0	75	66
3	90	71	79.2	66.7	0	16	92	38	68	0.00	28.34	29.80	SSE	19.6	34.6	18.79	73.9	73.7	80	70
4	88	58	76.8	65.4	0	8	97	43	70	0.88	28.35	29.82	S	18.1	45.0	18.22	75.4	75.7	82	71
5	66	47	56.5	39.4	8	0	86	29	55	0.06	28.61	30.09	N	10.2	32.4	18.40	65.1	64.6	71	60
6	73	44	57.2	35.2	6	0	87	20	49	0.00	28.63	30.11	NNW	9.8	32.7	20.96	60.1	58.9	64	54
7	76	45	60.0	41.3	4	0	90	21	56	0.00	28.66	30.13	ESE	4.6	11.5	20.26	62.6	61.2	70	54
8	81	47	62.7	42.9	1	0	81	23	53	0.00	28.56	30.03	SE	10.5	22.8	19.82	62.5	61.0	67	55
9	82	53	65.9	49.1	0	3	89	27	59	0.00	28.51	29.99	SE	13.2	28.3	19.41	64.0	62.7	70	57
10	83	59	69.8	56.2	0	6	81	41	64	0.00	28.45	29.92	SSE	15.6	33.5	18.78	66.9	66.2	74	60
11	86	58	71.8	50.3	0	7	88	15	54	0.00	28.35	29.82	S	12.8	28.3	19.08	69.7	69.6	77	64
12	75	56	64.1	47.3	0	0	79	37	56	0.00	28.57	30.05	NE	11.3	26.5	18.86	67.7	67.6	75	62
13	73	59	65.9	58.5	0	1	92	65	77	0.00	28.71	30.19	ESE	7.5	18.1	6.58	68.0	67.5	71	65
14	72	62	68.3	66.3	0	2	99	76	94	0.35	28.51	29.98	SSE	10.9	26.2	3.66	68.8	68.4	70	67
15	67	51	56.4	46.1	6	0	97	50	69	0.00	28.59	30.07	N	12.1	32.4	7.24	62.2	61.7	68	57
16	52	40	47.4	39.6	19	0	97	59	75	0.01	28.66	30.14	NNE	7.5	19.2	6.73	56.2	55.4	58	52
17	69	37	53.0	40.8	12	0	98	30	68	0.00	28.56	30.04	WSW	4.5	14.7	18.54	57.1	56.2	65	49
18	56	34	46.7	42.9	20	0	98	68	87	0.18	28.59	30.06	N	10.6	33.8	2.81	55.1	54.6	58	49
19	65	32	47.2	36.6	16	0	100	31	72	0.01	28.64	30.12	W	8.0	19.8	18.46	52.2	51.3	60	44
20	71	39	55.5	43.9	10	0	91	43	68	0.00	28.43	29.90	S	10.0	30.2	17.81	54.7	54.0	62	47
21	63	41	54.1	41.3	13	0	87	36	64	0.00	28.59	30.06	NNE	11.4	33.4	16.05	57.1	56.7	63	53
22	78	40	56.6	39.9	6	0	90	23	60	0.00	28.62	30.09	WSW	6.9	21.3	17.43	57.1	56.7	66	49
23	82	42	60.2	42.9	3	0	97	19	60	0.00	28.59	30.07	SW	7.7	21.5	17.25	59.3	59.2	68	52
24	61	43	51.8	40.1	13	0	96	41	66	0.00	28.78	30.27	NE	10.6	27.2	16.36	58.5	58.4	65	54
25	64	39	51.1	39.3	13	0	82	47	65	0.00	28.84	30.32	SSE	9.3	25.7	15.52	57.2	57.0	65	51
26	71	51	57.5	52.7	4	0	95	65	84	0.39	28.66	30.14	SSE	8.4	24.3	7.52	59.0	58.7	64	55
27	69	38	55.1	41.6	12	0	98	30	64	0.00	28.59	30.07	SSE	6.7	17.6	17.17	58.2	57.6	64	51
28	68	54	60.8	59.4	4	0	100	86	95	0.00	28.53	30.00	SSE	12.5	36.2	3.19	59.2	58.7	62	56
29	76	67	70.6	66.2	0	7	93	75	86	0.00	28.49	29.96	SSE	16.4	31.1	7.03	65.1	64.9	68	62
30	77	62	70.9	67.1	0	5	96	72	88	0.20	28.37	29.83	S	16.9	39.6	6.52	67.2	67.1	69	66
31	68	46	58.6	46.0	8	0	96	30	66	0.06	28.29	29.75	WNW	11.6	33.9	15.00	62.0	61.7	67	56
	74	50	61.2	49.3	<- Monthly Averages ->						28.55	30.02	SSE	11.0	45.0	14.41	62.6	62.1	68	57

Temperature - Highest: 90
Lowest: 32

Degree Days - Total HDD: 179
Total CDD: 73

Rainfall: Monthly Total: 2.14 in.
Greatest 24 Hr: 0.88 in.

Humidity - Highest: 100
Lowest: 15

Number of Days With:
Tmax ≥ 90: 1 — Rainfall ≥ 0.01 inch: 9
Tmax ≤ 32: 0 — Rainfall ≥ 0.10 inch: 5
Tmin ≤ 32: 1 — Avg Wind Speed ≥ 10 mph: 20
Tmin ≤ 0: 0 — Max Wind Speed ≥ 30 mph: 13

* Denotes incomplete record

Monthly data generated on Tuesday, December 31, 2013 at 11:39 UTC

Evaluating Field Trial Data

This article has been reprinted from Southwest Farm Press Vol 25, Number 11, April 9, 1998.

Field Trials can provide helpful information to producers as they compare products and practices for their operations. But field trials must be evaluated carefully to make sure results are scientifically sound, not misleading and indicate realistic expectations for on-farm performance.
This fact sheet is designed to give you the tools to help you determine whether data from a field trial is science fact or science fiction.

What are the best sources of field trial data?

Field trials are conducted by a broad range of individuals and institutions, including universities, ag input suppliers, chemical and seed companies and growers themselves. All are potentially good sources of information.

What are the common types of field trials?

Most field trials fall into one of two categories: side-by-side trials (often referred to as strip trials) or small-plot replicated trials. Side-by-side trials are the most common form of on-farm tests. As the name suggests, these trials involve testing practices or products against one another in plots arrayed across a field, often in strips the width of the harvesting equipment.
These strips should be replicated across the field or repeated at several locations to increase reliability. Small-plot replicated trials often are conducted by universities and companies at central locations because of the complexity of managing them and the special planting and harvesting equipment often required.
Replicated treatments increase the reliability of an experiment. They compare practices or products against one another multiple times under uniform growing conditions in several randomized small plots in the same field or location.
Small-plot replicated trials also may be conducted on farmers' fields where special conditions exist, for example, a weed infestation that does not occur on an experiment station.

Are side-by-side plots more valuable than small-plot replicated trials, or vice versa?

Both types of plots can provide good information. The key is to evaluate the reliability of the data. It is also important to consider the applicability of the trial to your farming operation.

When is plot data valid, and when isn't it?

There isn't a black-and-white answer to that questions. But there are good rules of thumb that can help guide you. Consider these three field trial scenarios:

Scenario 1:

A single on-farm side-by-side trial comparing 10 varieties. Each variety is planted in one strip the width of the harvesting equipment and is 250 to 300 feet long.

What you can learn:

This trial will allow you to get a general feel for each variety or hybrid in the test, including how it grows and develops during the season.
However, this trial, by itself, probably won't be able to reliably measure differences in yield. This is because variability within the field, even if it appears to be relatively uniform, may be large enough to cause yield variations that mask genetic difference among the varieties. Other varietal characteristics, such as maturity or micronaire in cotton, can also be masked by soil variation.

Scenario 2:

Yield data from side-by-side variety trials conducted on the same varieties on multiple farms in your region.

What you can learn:

When data from multiple side-by-side trials are considered together, reliability increases. In this case, the more trials comparing the same varieties, the better. As you go from three to five to 10 or more locations, the certainty goes up that yield differences represent genetic differences and not field variability. Be aware, however, that small differences between treatments (in this case varieties) may still be within the margin of random variability of the combined trial and may not indicate actual genetic differences. One treatment will almost always be numerically higher. Statistical analysis helps determine if differences are significant (consistent).

Scenario 3:

A university-style small-block replicated trial comparing the same 10 varieties.

What can you learn:

Data from such trials, if they are designed well and carried out precisely, generally are reliable. This is, the results generally determine the yield potential of crop varieties. However, it is still important to consider whether results are applicable to your farming operation and are consistent with other research.

How do I know whether differences in yield, for example, are real and not caused by field variability or sloppy research?

Scientists use statistical analysis to help determine whether differences are real or are the result of experimental error, such as field variation. The two most commonly used statistics are **Least Significant Difference (LSD)** and the **Coefficient of Variation (CV)**, both of which can provide insight on the validity of trial data. If these values aren't provided with trial results, ask for them.

Least Significant Difference (LSD) is the minimum amount that two varieties must differ to be considered significantly different. Consider a trial where the LSD for yield is four bushels per acre. If one variety yields 45 bushels per acre and another yields 43 bushels per acre, the two are not statistically different in yield. The difference in their yields is due to normal field variation, not to their genetics. In this example, a variety that yields 45 bushels per acre is significantly better than those yielding less than 41 bushels per acre. In many research trials, LSDs are calculated at confidence level of 75 to 95 percent. For example, a confidence level of 95 percent means you can be 95 percent certain that yield differences greater than the LSD amount are due to genetics and not to plot variability.

Coefficient of Variation (CV) measures the relative amount of random experimental variability not accounted for in the design of a test. It is expressed as a percent of the overall average of the test.

For measuring yield differences, CV's of up to five percent are considered excellent; 5.1 to 10 percent are considered good; and 10.1 to 15 percent are fair.

A high CV means there must be larger differences among treatments to conclude that significant differences exist. The bottom line: <u>When considering yield test data, be skeptical when the CV exceeds 15 percent.</u>

Is a one-year test valid, or are several years of results necessary to know whether one product or practice is superior to another?

In an ideal world, having several years of tests to verify use of a practice or product is best. But where changes are rapid, such as with crop varieties, having university data from multiple years isn't always possible.

When multi-year university data aren't available, pay more careful attention to statistical measures like CV and LSD, and the number of locations and testing environments.

Multi-year data on yield and performance can also be requested from the developers of new products prior to university testing. In either case, be cautious about making major production changes and trying large acreages of a given variety based on one year's data.

How should I evaluate trial results that are markedly different from other research in my area?

When research results are at odds with the preponderance of scientific evidence, examine the new research with extra care.

Pay special attention to factors that might have influenced the outcome, such as soil type, planting date, soil moisture and other environmental conditions, and disease, insect and weed pressures. For example, was the growing season unusually wet or unusually dry? When was it dry or wet? What was the crop growth stage when it was wet or dry?

Was there a disease that affected one variety or hybrid more than another one? Were there insect problems? Could this have influenced the trial's outcome and its applicability to your operation? If you determine that unusual circumstances affected the outcome, be cautious about how you use the results.