



Use of LONREN Germplasm in a Breeding Program

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LONREN germplasm introgression

- Crosses have been made between several adapted cultivars and LONREN germplasm
- First population developed was LONREN-1 × Fibermax 966 (2007)
- Objectives (among others) were to observe effects of *REN^{lon}* gene on
 - Reaction to nematodes
 - Agronomic traits (with and without nematodes)
 - Fiber quality

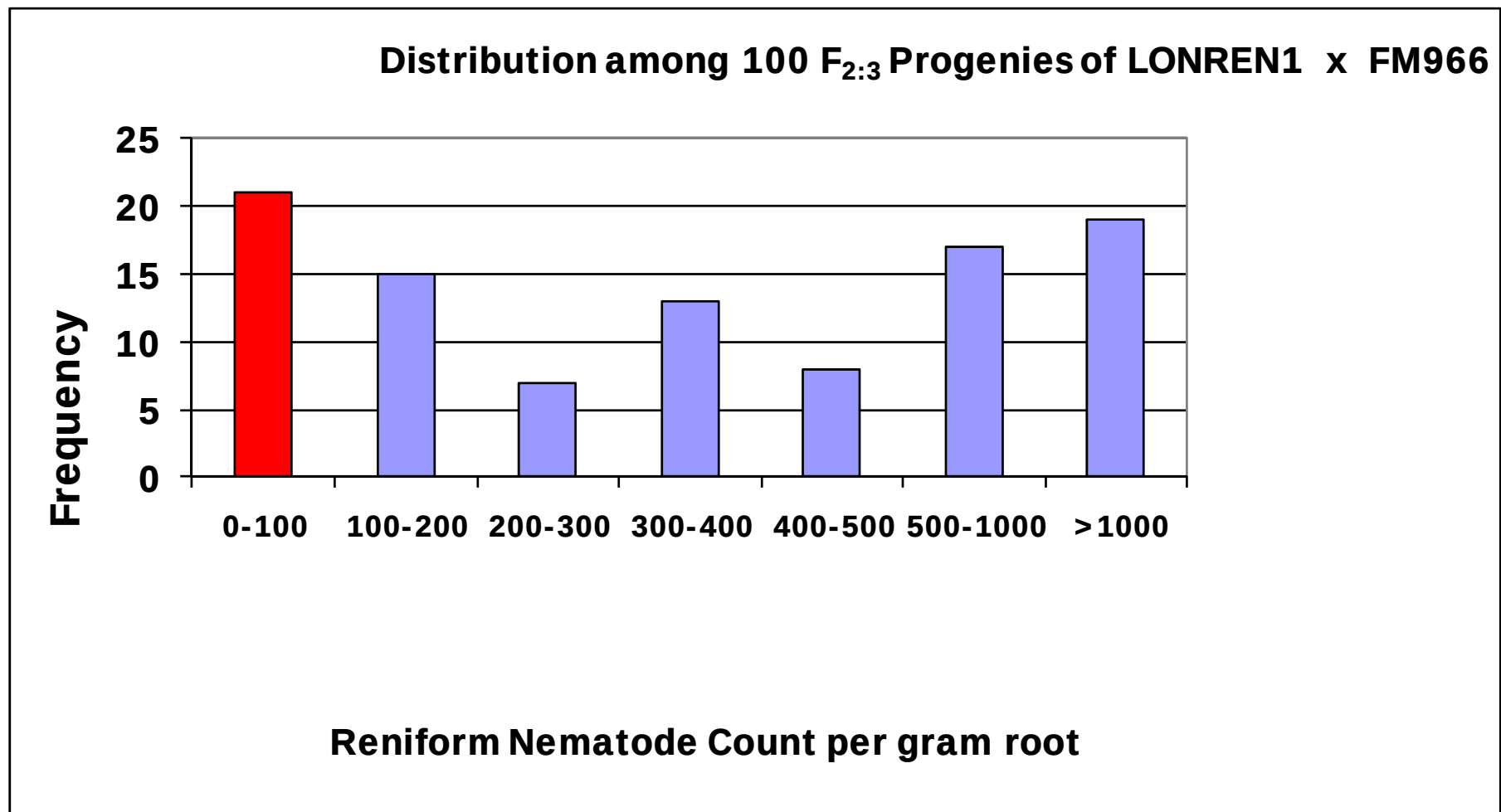


LONREN germplasm introgression

- Lines advanced to F_{2:3} generation
- 100 random lines subjected to nematode screening in greenhouse using standard protocols
- Lines evaluated for presence/absence of SSR marker BNL1066_156



Distribution of 100 random $F_{2:3}$ lines



Study initiated to determine effects of *REN^{lon}* gene in LONREN on agronomic and fiber traits

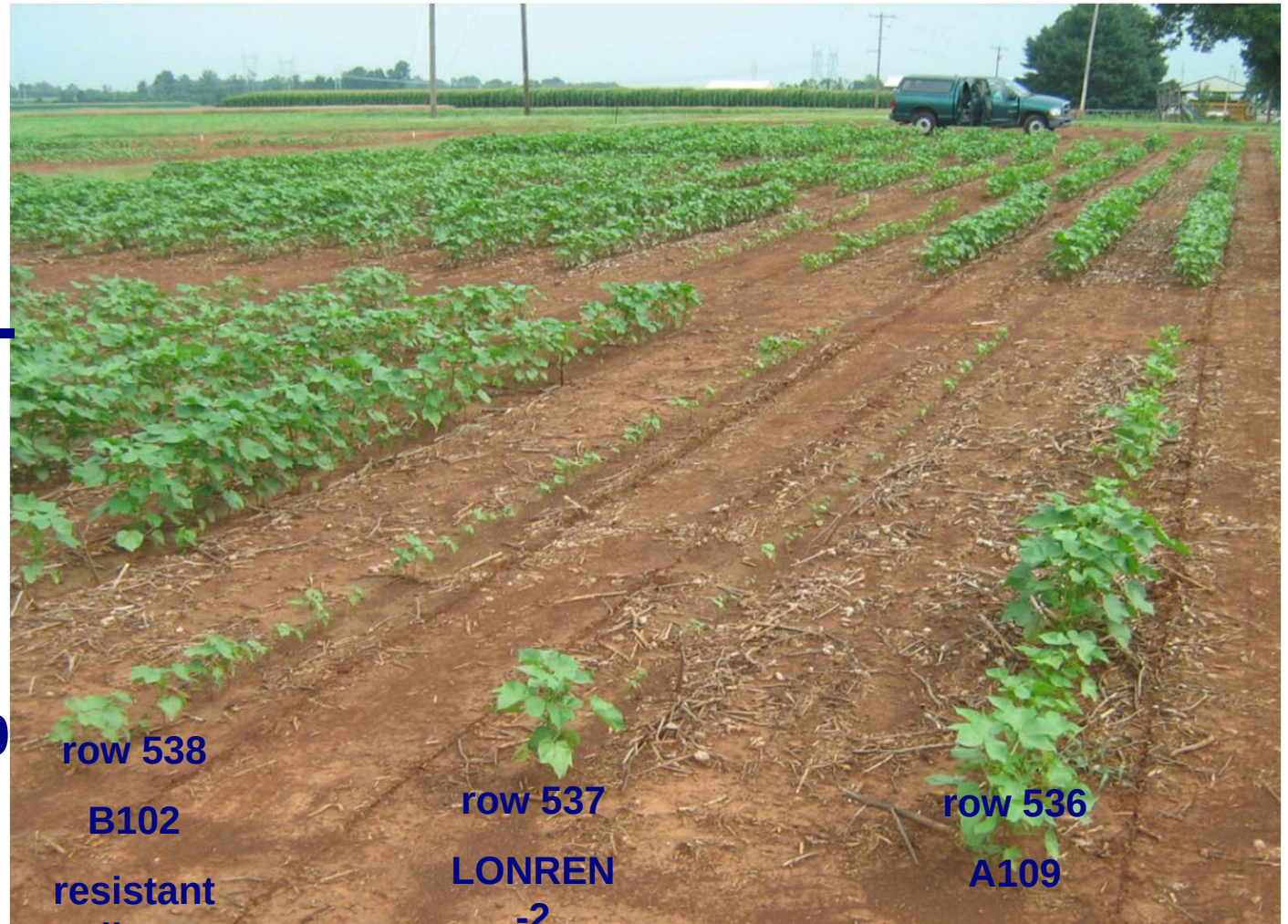
- Field experiments in nematode-infested fields (resistant and susceptible lines – 20 each, plus checks LONREN-1 and LONREN2, FM 966, DP 393)
 - 5 replicate 25 foot single row plots in infested and noninfested (confirmed by sampling) adjacent fields
 - Agronomic and fiber quality data collected



**Seedling
Stunting
nematode-
infested
field**

June 16, 2010

**46 days after
planting**



row 538

B102

resistant
line

row 537

LONREN
-2

row 536

A109

susceptible
line



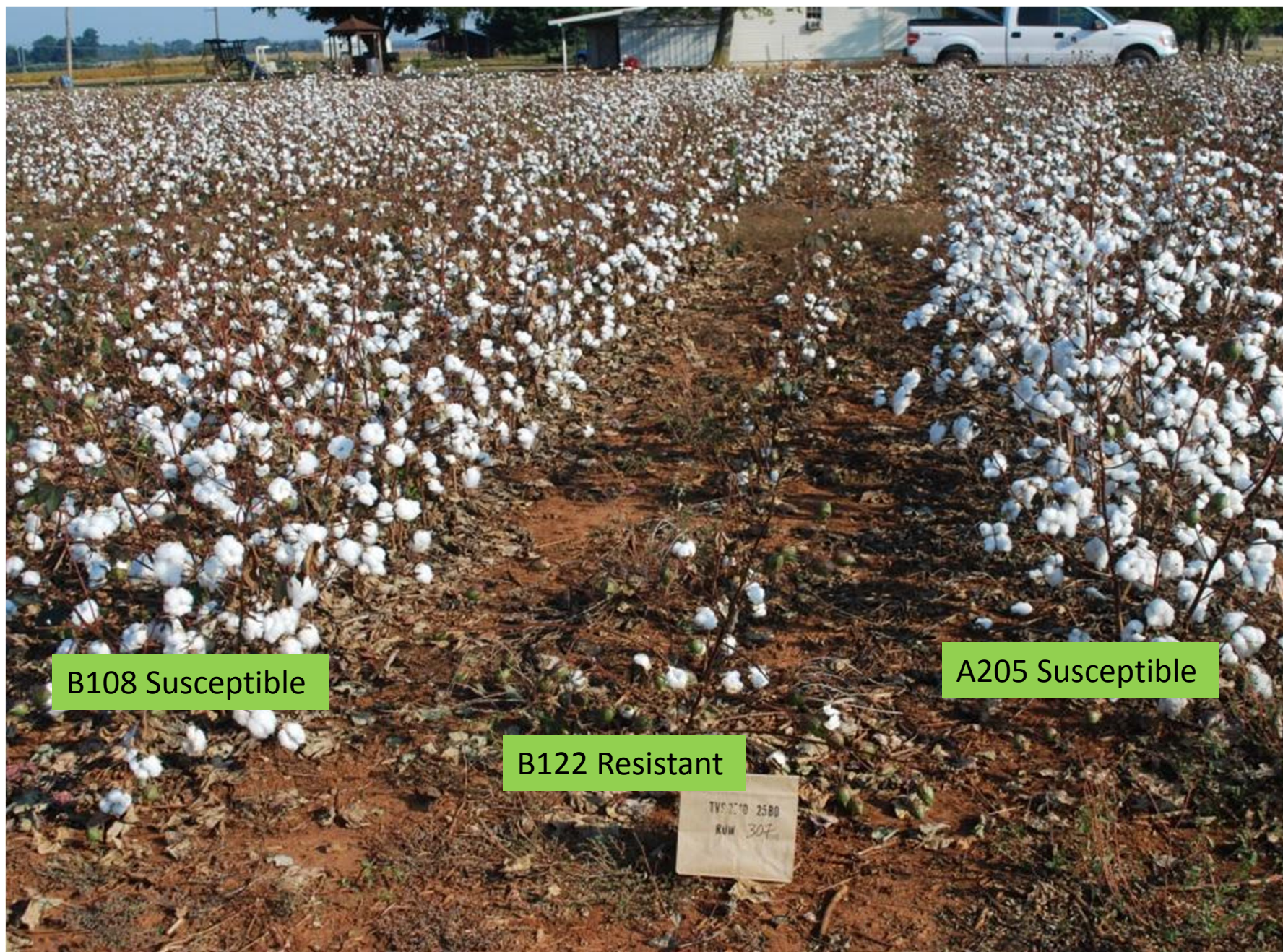


**Healthy
Stand
non-
nematode
-infested
field**

June 16, 2010

**46 days after
planting**





B108 Susceptible

A205 Susceptible

B122 Resistant

TVS 2580
RUM 307

Yields - TVREC 2010

Group means / Contrasts	Reniform present			Reniform absent			Yield Reduction
	Yield Estimate	StdErr	Probt	Yield Estimate	StdErr	Probt	
	(lbs/acre)			(lbs/acre)			
<u>Group means</u>							
Resistant lines	834	79.6		1372	52.0		39%
Susceptible lines	1071	79.6		1448	52.0		26%
LONREN-1 and -2	845	151.8		1433	89.3		41%
Susceptible checks	913	151.8		1405	89.3		35%
<u>Group mean differences</u>							
Resistant vs. susceptible lines	-237	60.9	0.0171	-76	34.3	0.2079	
Resistant vs. LONREN-1 and -2	-11	142.9	1.0000	-61	80.3	0.9331	
Susc. lines vs. susc. checks	158	142.9	0.7857	43	80.3	0.9818	
LONREN-1 + 2 vs. susc. checks	-68	192.7	0.9960	28	108.3	0.9988	

Yields - TVREC 2011

	<u>Reniform present</u>			<u>Reniform absent</u>			
	Yield			Yield			Yield
<u>Group means / Contrasts</u>	Estimate	StdErr	Probt	Estimate	StdErr	Probt	<u>Reduction</u>
	(lbs/acre)			(lbs/acre)			
<u>Group means</u>							
Resistant lines	782	42.8		920	19.8		15%
Susceptible lines	921	41.9		962	19.8		4%
LONREN-1 and -2	746	132.4		906	54.7		18%
Susceptible checks	1044	132.4		1031	54.7		-1%
<u>Group mean differences</u>							
Resistant vs. susceptible lines	-138	59.4	0.1096	-43	24.0	0.3685	
Resistant vs. LONREN-1 and -2	36	139.2	0.9987	13	56.4	0.9991	
Susc. lines vs. susc. checks	-123	138.9	0.8762	-68	56.4	0.7113	
<u>LONREN-1 + 2 vs. susc. checks</u>	<u>-298</u>	<u>187.3</u>	<u>0.4362</u>	<u>-124</u>	<u>76.0</u>	<u>0.4474</u>	

Two-year average – Lint Yield

Group means / Contrasts	Reniform present			Reniform absent			Yield Reduction
	Yield Estimate	StdErr	Probt	Yield Estimate	StdErr	Probt	
	(lbs/acre)			(lbs/acre)			
<u>Group means</u>							
Resistant lines	808	44.3		1146	27.3		29%
Susceptible lines	996	44.1		1205	27.3		17%
LONREN-1 and -2	796	100.5		1170	52.9		32%
Susceptible checks	979	100.5		1218	52.9		20%
<u>Group mean differences</u>							
Resistant vs. susceptible lines	-188	42.8	0.0023	-59	21.4	0.0584	
Resistant vs. LONREN-1 and -2	13	100.0	1.0000	-24	50.1	0.9868	
Susc. lines vs. susc. checks	17	99.9	0.9998	-13	50.1	0.9987	
LONREN-1 + 2 vs. susc. checks	-183	134.7	0.6248	-48	67.5	0.9446	

Year × Line interaction for Yield: Not significant

Lint quality - 2010

Group means

Group	Micronaire		UHM Length		Uniformity		Fiber Strength		Elongation		Short Fiber	
	non-RN		non-RN		non-RN		non-RN		non-RN		non-RN	
	RN field	field	RN field	field	RN field	field	RN field	field	RN field	field	RN field	field
Resistant lines	5.1	5.0	1.06	1.07	83.7	83.5	31.7	31.4	4.9	4.7	7.4	7.5
Susceptible lines	4.9	5.1	1.08	1.08	83.3	83.1	30.1	30.2	4.9	4.7	7.6	7.8
LONREN-1 and -2	4.8	5.0	1.05	1.06	83.2	83.3	29.8	29.8	5.3	4.5	8.0	7.9
Susceptible checks	4.8	4.7	1.11	1.12	83.9	83.3	31.4	31.1	5.1	4.9	7.3	8.1

Significant group mean difference

Trait	Group	Location	Standard Error	Probability
Fiber Strength	Resistant vs. susceptible lines	Nematode field	0.33	0.0071
		Non-nematode field	0.29	0.0013

All other group mean differences are not significant

Lint quality - 2011

Group means

Group	Micronaire		UHM Length		Uniformity		Fiber Strength		Elongation		Short Fiber	
	non-RN		non-RN		non-RN		non-RN		non-RN		non-RN	
	RN field	field	RN field	field	RN field	field	RN field	field	RN field	field	RN field	field
Resistant lines	4.5	4.7	1.14	1.12	84.2	84.5	33.2	34.3	5.7	4.3	6.8	6.8
Susceptible lines	4.5	4.7	1.14	1.13	83.6	84.3	31.1	32.1	6.0	4.6	7.1	6.7
LONREN-1 and -2	4.3	4.5	1.13	1.12	83.4	84.6	30.7	31.9	5.7	4.2	8.0	6.6
Susceptible checks	4.5	4.5	1.19	1.16	84.8	85.0	32.6	32.6	6.2	4.7	7.3	6.6

Significant group mean difference

Trait	Group	Location	Standard Error	Probability
Fiber Strength	Resistant vs. susceptible lines	Nematode field	0.18	0.0000
		Non-nematode field	0.18	0.0000
Elongation	Resistant vs. susceptible lines	Nematode field	0.05	0.0012
		Non-nematode field	0.00	0.0000

Two-year average - Lint quality

Group means

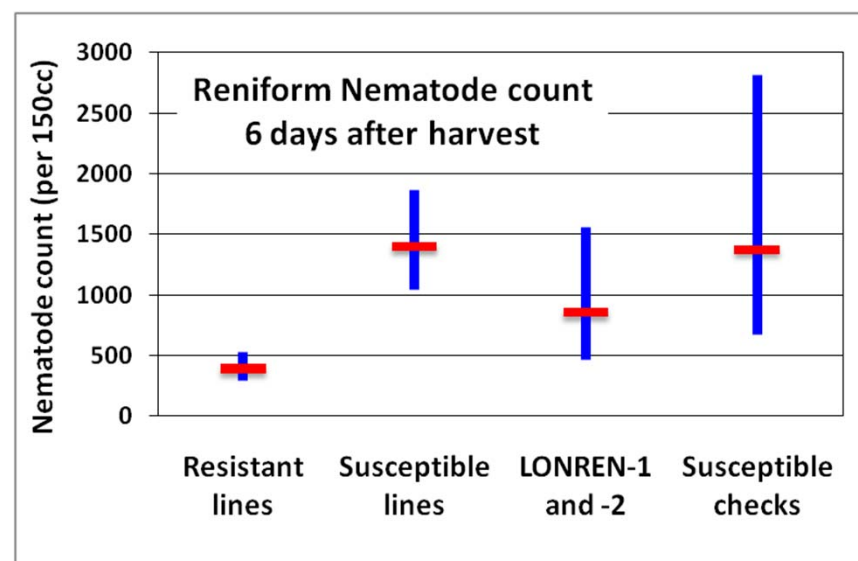
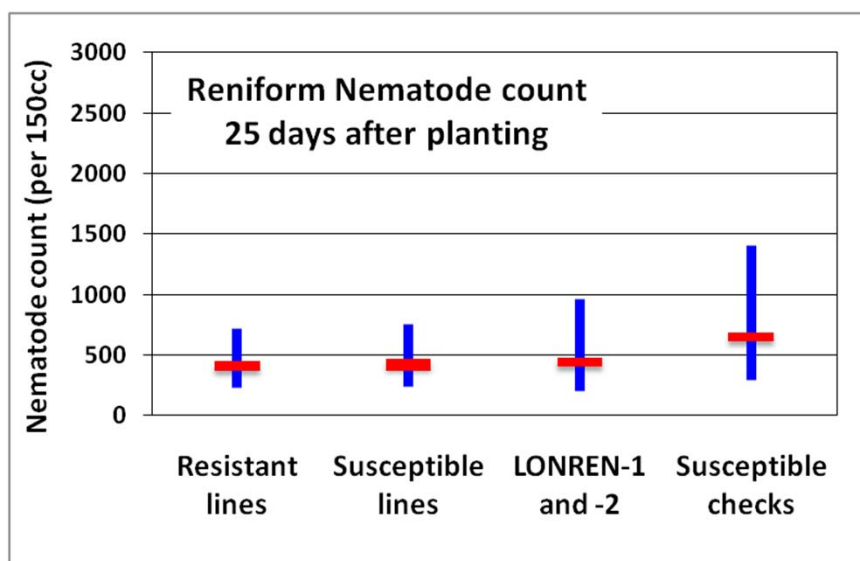
Group	Micronaire		UHM Length		Uniformity		Fiber Strength		Elongation		Short Fiber	
	non-RN		non-RN		non-RN		non-RN		non-RN		non-RN	
	RN field	field	RN field	field	RN field	field	RN field	field	RN field	field	RN field	field
Resistant lines	4.8	4.8	1.10	1.10	84.0	84.0	32.4	32.8	5.3	4.5	7.1	7.0
Susceptible lines	4.7	4.9	1.11	1.10	83.5	83.7	30.6	31.1	5.4	4.7	7.3	7.3
LONREN-1 and -2	4.5	4.7	1.09	1.09	83.3	83.9	30.2	30.9	5.5	4.4	7.6	7.3
Susceptible checks	4.6	4.6	1.15	1.14	84.3	84.1	32.0	31.7	5.6	4.8	7.1	7.3

Significant group mean difference

Trait	Group	Location	Standard Error	Probability	Year × Line?
Fiber Strength	Resistant vs. susceptible lines	Nematode field	0.21	0.0000	No
		Non-nematode field	0.18	0.0000	Yes
Uniformity	Resistant vs. susceptible lines	Nematode field	0.09	0.0001	Yes
		Non-nematode field	0.27	0.0697	No
Short Fiber	Resistant vs. susceptible lines	Nematode field	0.21	0.0022	No
		Non-nematode field	0.18	0.0035	No

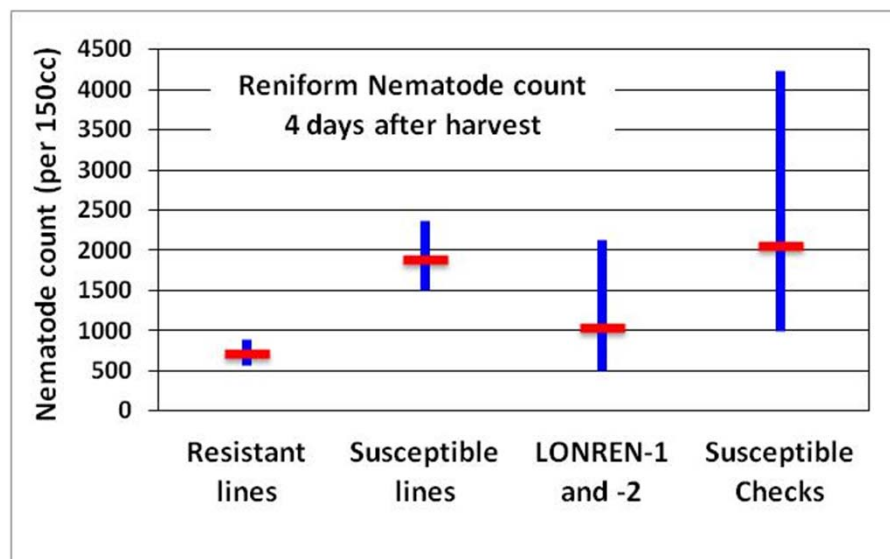
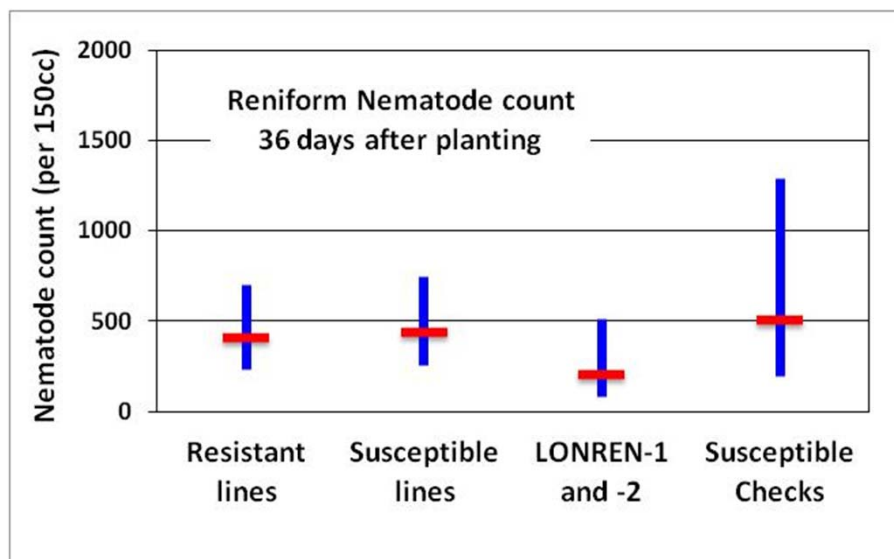
Nematode counts - 2010

Group means / Contrasts	25 days after planting				6 days after harvest			
	Lower		Upper	Probt	Lower		Upper	Probt
	Est.	CL	CL		Est.	CL	CL	
<u>Group means</u>								
Resistant lines	407	230	719		392	291	528	
Susceptible lines	425	241	751		1396	1043	1868	
LONREN-1 and -2	440	202	959		854	467	1560	
Susceptible checks	645	296	1405		1373	670	2815	
<u>Group mean differences</u>								
Resistant vs. susceptible lines	-19			0.9980	-1004			0.0003
Resistant vs LONREN-1 and -2	-33			0.9995	-462			0.0727
Susc. lines vs. susc. checks	-219			0.7282	23			1.0000
LONREN-1 + 2 vs. susc. checks	-205			0.9115	-519			0.7874



Nematode counts - 2011

Group means / Contrasts	36 days after planting				4 days after harvest			
	Lower		Upper		Lower		Upper	
	Est.	CL	CL	Probt	Est.	CL	CL	Probt
<u>Group means</u>								
Resistant lines	403	234	696		703	558	884	
Susceptible lines	432	250	745		1885	1499	2371	
LONREN-1 and -2	201	78	514		1025	496	2118	
Susceptible checks	503	196	1286		2051	993	4236	
<u>Group mean differences</u>								
Resistant vs. susceptible lines	-28			0.9966	-1183			0.0000
Resistant vs LONREN-1 and -2	203			0.5257	-323			0.8321
Susc. lines vs. susc. checks	-71			0.9971	-166			0.9989
LONREN-1 + 2 vs. susc. checks	-303			0.5503	-1025			0.6017



Conclusions – Field studies

- Lines with *REN^{lon}* gene tended to be lower-yielding under nematode pressure than sister lines without the gene
- Lines with *REN^{lon}* gene had lower at-harvest nematode numbers, and were effective at reducing nematode populations compared to susceptible sister lines
- *REN^{lon}* chromosome segment promoted greater fiber strength, tended to improve uniformity and lower short fiber content

Inoculation density studies

- Focus on response of resistant and susceptible lines to inoculum levels under controlled conditions
- Six genotypes: Two susceptible cultivars, LONREN-1 and LONREN-2 (resistant) and one each of $F_{2:3}$ resistant and susceptible progenies
- Inoculated with 0, 500, 1000, 5000, 10,000 and 50,000 per cone-tainer

Line B104
(LONREN-1 ×
Fibermex 966)
(resistant)
response to
increasing levels
of reniform
inoculum



Line B108
(LONREN-1 ×
Fibermex 966)
(susceptible)
response to
increasing levels
of reniform
inoculum



Summary of observations

Resistant LONREN genotypes:

- limited damage at lower R.N. population levels
- considerable root damage at higher R.N. population levels
- root damage occurs at early seedling stage, with simultaneous shoot stunting

Susceptible genotypes:

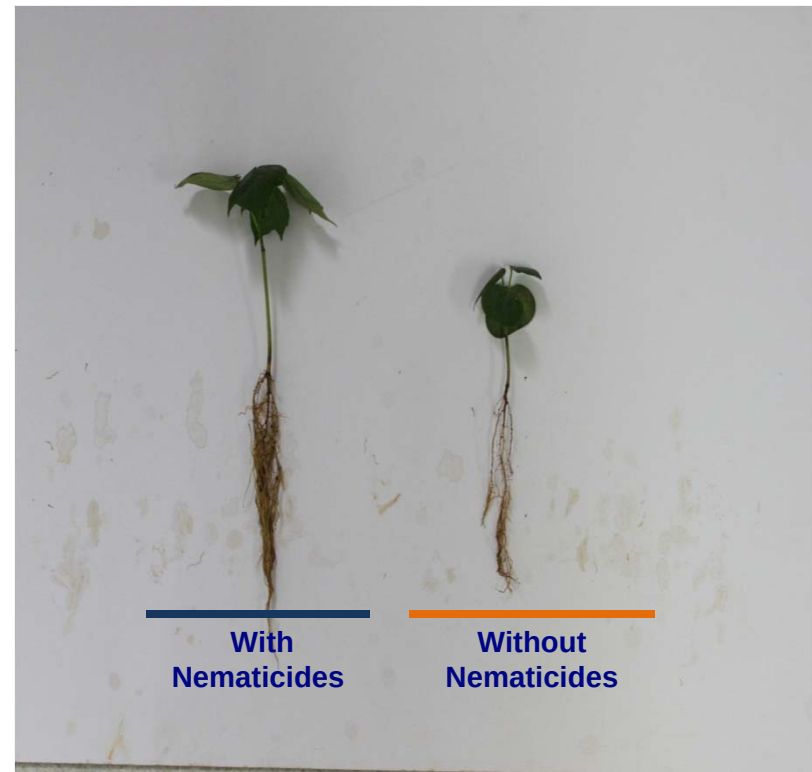
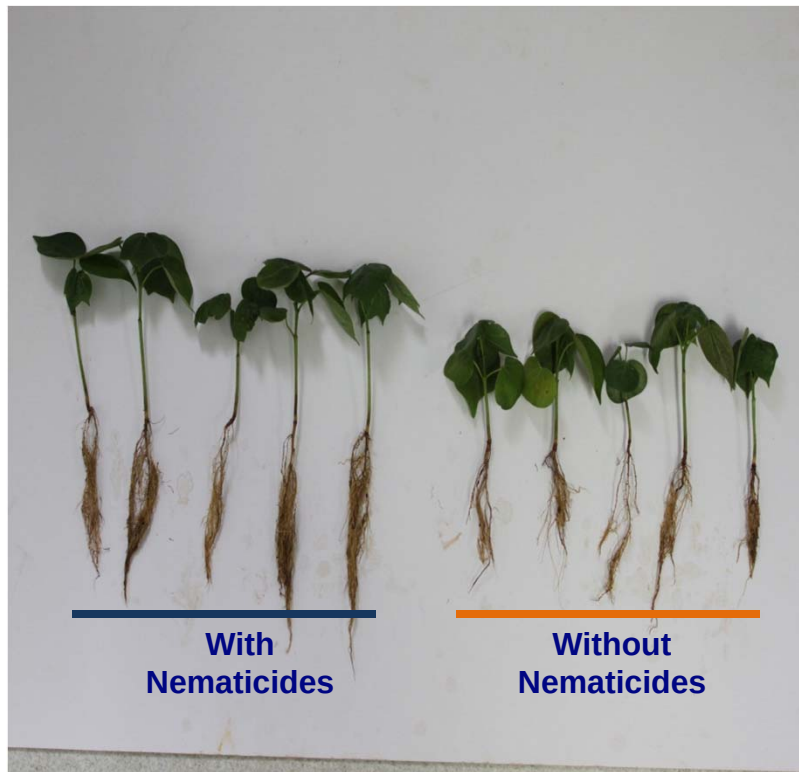
- initial response to reniform nematode is increased root development
- delayed shoot stunting



LONREN-1 - 31 days after inoculation



Greenhouse Trial Resistant Line A107



- Significant increases in plant heights, root fresh weights, and shoot fresh weights at 60DAP



Increase in plant height at 45 DAP



Resistant Line LONREN-1
With Nematicides



Resistant Line LONREN-1
Without Nematicides

Increase in plant height at 45 DAP



Resistant Line B219
With Nematicides



Resistant Line B219
Without Nematicides



Evaluation of LONREN Breeding Lines With Nematicides

- Some benefits from nematicide were observed for LONREN breeding lines in greenhouse conditions.
 - Reduction in the amount of females/g root, significantly in resistant line A122
 - Significant increases in plant heights, root fresh weights, and shoot fresh weights at 60DAP
- Some benefits from applying nematicides to LONREN breeding lines were observed in early season growth parameters in field trials.
 - Suppression of reniform populations at 30 and 60 DAP
 - Increase in plant height at 30 and 45 DAP
- However, little yield increases were influenced by nematicides.

