A close-up photograph of a bird's head, showing its eye and beak. The bird is looking towards the left. The background is dark and out of focus.

# Release, Registration, and Potential of BARBREN 713 and Related Lines for Nematode and Seedling Disease Control

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## Background

2004 – Robinson et al. report that *Gossypium barbadense* GB 713 suppresses reniform nematode reproduction.

2010 – Gutiérrez et. al. conclude resistance of GB 713 is due to three QTL:

***Ren<sup>barb-1</sup>*** (bordered by BNL 1551\_162 and GH 132\_199 on Chromosome 21)

***Ren<sup>barb-2</sup>*** (bordered by BNL 4022\_199 and BNL 3279\_106 on Chromosome 21)

***Ren<sup>barb-3</sup>*** (bordered by BNL 1721\_178 and BNL 569\_131 on Chromosome 18)

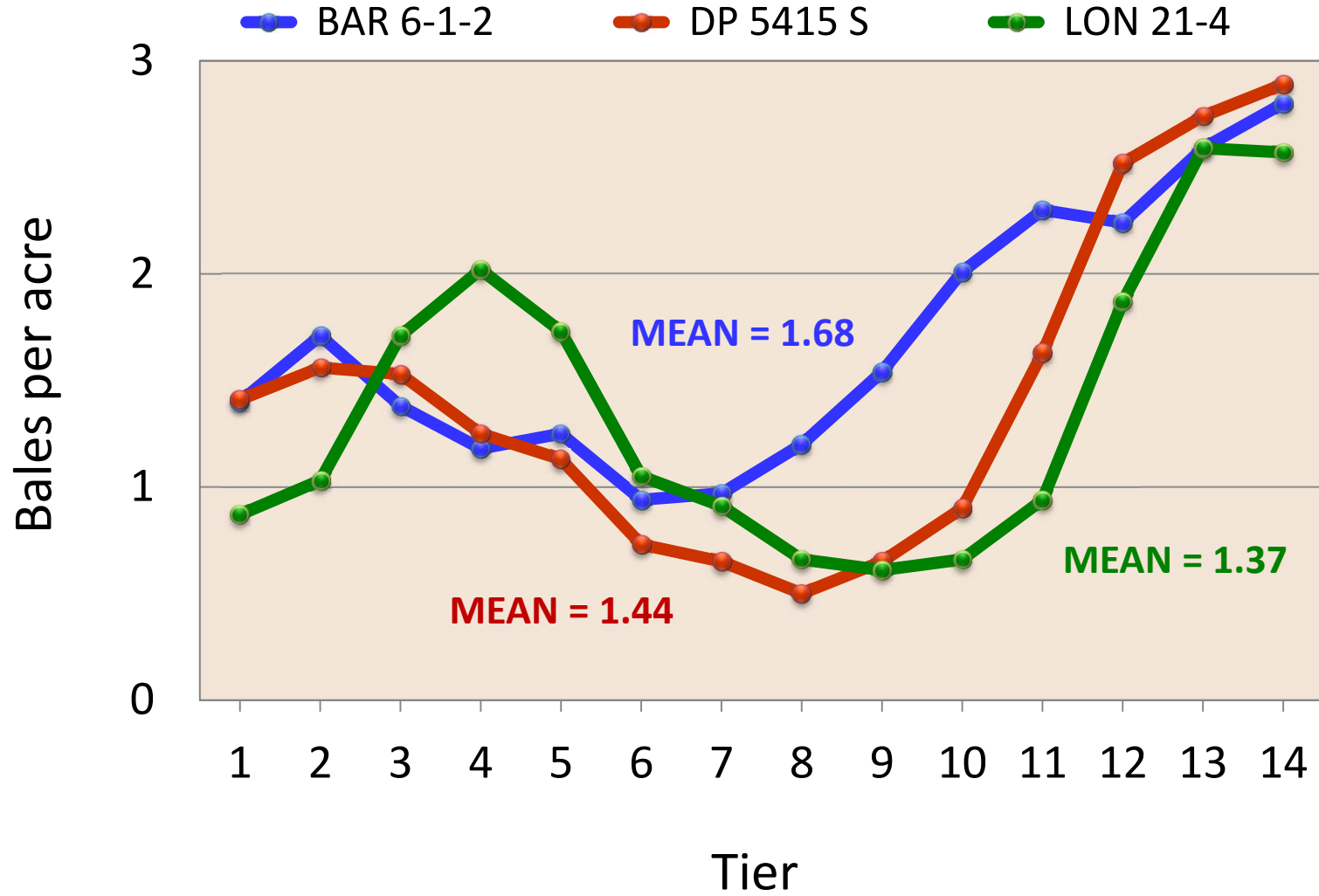
2012 – USDA, MAFES, TAMU Agri Life, and Cotton Inc. release BARBREN 713 for dual resistance to reniform and root-knot nematodes (*Ren<sub>2</sub>*, *Ren<sub>3</sub>*, *Mi<sub>1</sub>*, and *Mi<sub>2</sub>*).



**DP 5415 S**

**BAR 6-1-2**

# 2011 COTTON YIELDS OF BAR 6-1-2 AND LON 21-4 COMPARED TO DP 5415 S (TAMU FARM)



**POST-HARVEST AND PRE-PLANT  
RENIFORM NEMATODE CONCENTRATIONS\*  
FOLLOWING RESISTANT CULTIVARS PLANTED AFTER CORN**

Sampling Date	2010 Cultivar/Line			
	LONREN 21-4	Deltapine 5415 S	BAR 6-1-2	LONREN 21-4
11/12/2010	6.0	13.5	2.6	3.4
5/23/2011	15.0	23.3	6.4	20.8

\* Number of nematodes per gram of soil.

**EFFECTS OF BARBREN AND LONREN ROTATION (2010)  
ON SECOND YEAR COTTON YIELDS (2011)**

2011 Line/Cultivar	2010 Line/Cultivar		
	LON 21-4	DP 5415 S*	BAR 6-1-2
	Grams of cotton per 35 feet		
LON-MO	431	152	365
LON-MM	382	132	296
DP 5415 S*	558	363	475
LON-ME	498	324	588
LON-MR	773	405	1149
MEAN	582 (0.40 bales/acre)	275 (0.19 bales/A)	575 (0.39 bales/A)

\* Very susceptible to reniform nematode; LON 21-4 and BAR 6-1-2 suppressed nematode concentrations in 2010.

## Selection and Evaluation Protocols

- 1) A. Forest Robinson used reniform nematode assays and crossing/backcrossing to transfer resistance from GB 713, over five or six generations, into *G. hirsutum* lines.
- 2) Plants selected from his materials for the presence of the BNL 3279\_105 marker and resistant to reniform nematode were crossed for two generations with various cultivars.
- 3) F<sub>2</sub> plants from the final cross were selected for the presence of BNL 3279\_105 and CIR 316\_202.
- 4) F<sub>3</sub> plants from F<sub>2</sub> selections were evaluated under a controlled environment protocol and in the field for resistance to reniform nematode and for agronomic performance.
- 5) F<sub>4</sub> plants from F<sub>3</sub> selections were evaluated in the greenhouse and in the field for resistance to reniform nematode-fungal disease complexes and agronomic performance.

## CROSSES USED IN STUDY

BAR Lines	Parent of BAR Germplasm*	Crossing Parents	
		First Cross	Second Cross
1-4	06 : 104-3 : 1	DP 393	PSC 355
5-8	06 : 104-3 : 1	DP 393	FM 958
9-12	06 : 104-3 : 10	SG 747	PSC 355
13-16	06 : 104-3 : 10	SG 747	FM 966
17-20	07 : 1-2 : 5	FM 958	DP 5415 S
21-24	07 : 1-2 : 5	FM 958	PSC 355
25-28	07 : 1-5 : 5	FM 966	DP 5415 S
29-32	07 : 1-5 : 5	FM 966	PSC 355
33-36	07 : 13-11 : 7	FM 958	DP 5415 S
37-40	07 : 13-11 : 7	FM 958	PSC 355
41-44	07 : 13-11 : 10	FM 966	DP 5415 S
45-48	07 : 13-11 : 10	FM 966	PSC 355
49-52	Unknown	FM 966	PSC 355
53-56	06 : 104-5 : 8	FM 966	PSC 355
57-60	07 : 102-9	FM 966	PSC 355

\* Developed by A. Forest Robinson prior to his retirement in 2008. Plants were generated from 5 or 6 crosses and backcrossed into root-knot nematode resistant lines.



**PAIRED-ROW COMPARISONS OF COTTON YIELD  
(CULTIVARS VS BAR LINES, TAMU FARM)**

Comparison†		Yield Lbs. per 35 feet (bales/A)		Yield Increase in BAR Lines (%)
Cultivar	BAR Lines	Cultivar	BAR Lines	
M-315 (CK)	6-1-2 (CK)	3.14 (0.98)	4.75 (1.48)	51
FM 958	5A*, 5B*,13	4.42 (1.38)	7.55 (2.35)	71
PSC 355	4*, 21*, 48*	4.75 (1.48)	7.76 (2.41)	63
DP 5415 S	25A*, 25B*, 44*	5.36 (1.67)	7.60 (2.37)	42
DP 491	11, 33, 44	3.85 (1.20)	6.24 (1.94)	62
PSC 355	30*, 37*, 51*	2.12 (0.66)	4.24 (1.32)	100
DP 393	2, 15, 18	5.06 (1.57)	6.19 (1.93)	22
STV 474	18, 32, 35	5.35 (1.67)	8.36 (2.60)	56
DP 493	7, 33, 39	5.17 (1.61)	7.12 (2.22)	38
Tamcot Sphinx	41, 54, 59	2.59 (0.81)	7.10 (2.21)	174
MEAN		4.18 (1.30)	6.69 (2.08)	60

**MEAN INCREASE: 0.78 bales/A → Net. income of \$375 per acre**

† In each case 4 rows of a cultivar were paired with 4 rows of each BAR line. Yields are means of all comparisons with a specific cultivar.

\* The final crossing parent was the same as the cultivar compared.

## FREQUENCY OF HIGH YIELDING ROWS

Yield Range (bales/A)	BAR Lines	Cultivars
Over 4.0	3	0
3.6 – 4.0	6	0
3.0 – 3.5	10	1
TOTAL	19	1



**FM 958**

**BAR 5**



**DP 491**

**BAR 11**



**BAR 48**

**PSC 355**



**Tamcot Sphinx**

**BAR 41**

## EFFECT OF GENOTYPE ON NEMATODE CONCENTRATIONS IN THE GREENHOUSE BIOASSAY

Genotype*			Number of Plants	Reniform Nematodes Per Gram
BNL 3279_105	BNL 1551_162	BNL 569_131		
- -	- -	- -	5	76.7
+(±)	- -	- -	68	21.7
+(±)	+(±)	- -	124	21.1
+(±)	- -	+(±)	20	15.8
+(±)	+(±)	+(±)	42	18.7

\* BNL 3279\_105, BNL 1551\_162, and BNL 569\_131 are closely linked to putative genes *Ren<sup>barb-2</sup>*, *Ren<sup>barb-1</sup>* and *Ren<sup>barb-3</sup>*, respectively (Gutiérrez et al., 2010).

## EFFECT OF GENOTYPE ON COTTON YIELD

Genotype*			Number of Rows	Yield Increase Relative to Cultivars (%)
BNL 3279_105	BNL 1551_162	BNL 569_131		
--	--	--	112	100
+(±)	--	--	27	187
+(±)	+(±)	--	48	178
+(±)	--	+(±)	9	177
+(±)	+(±)	+(±)	27	171

\* BNL 3279\_105, BNL 1551\_162, and BNL 569\_131 are closely linked to putative genes *Ren<sup>barb-2</sup>*, *Ren<sup>barb-1</sup>* and *Ren<sup>barb-3</sup>*, respectively (Gutiérrez et al., 2010).



## EFFECT OF CIR 316 ON COTTON YIELD

Genotype	Number of Rows	Yield Increase Relative to Cultivars (%)
+ CIR 316_202	64	177
- CIR 316_202	40	217

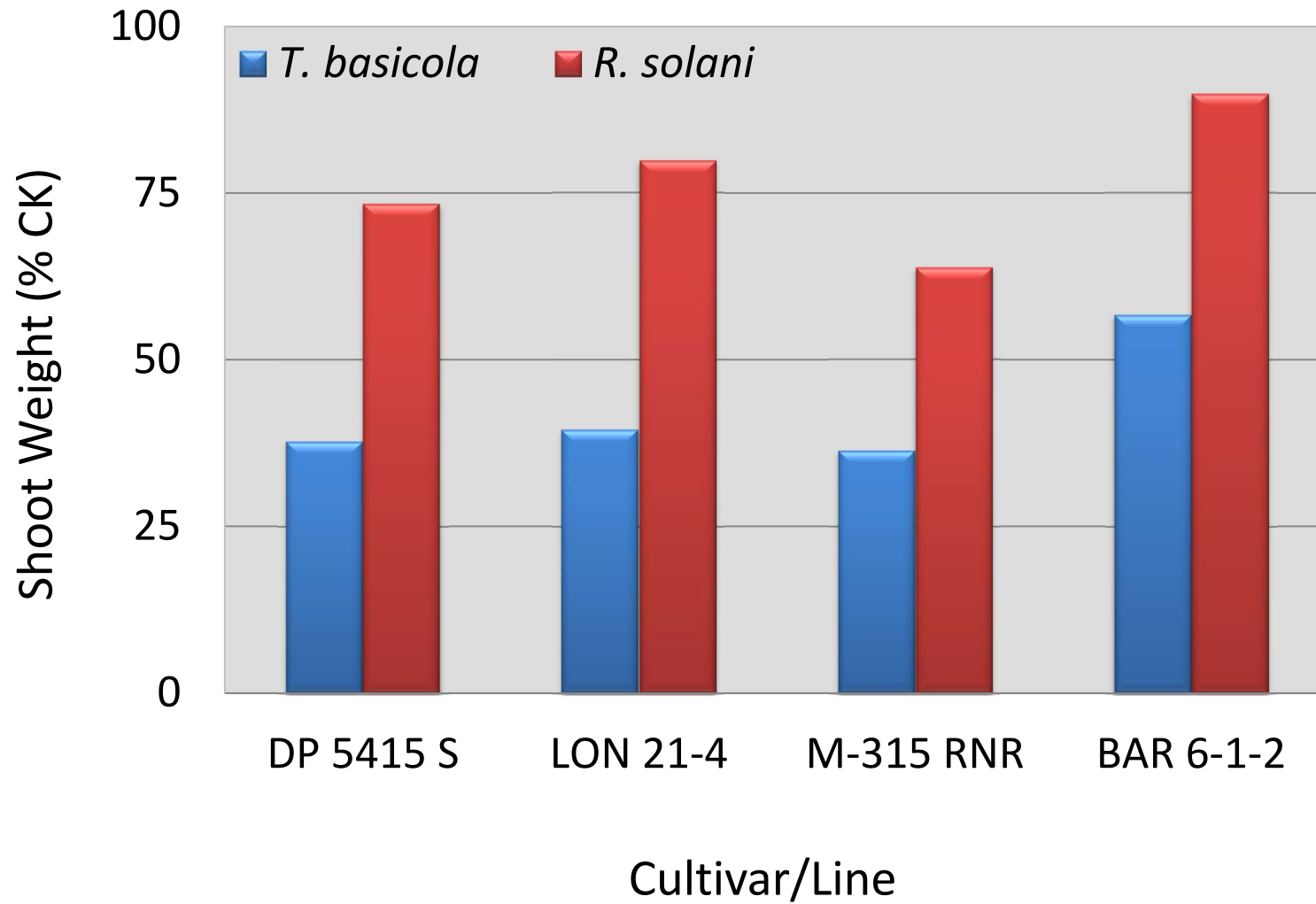
## RELATIONSHIPS BETWEEN BAR GRANDPARENT AND FIBER QUALITY

BAR Grandparent	MIC	UHM	UI	STR	ELO	No. Lines
06: 104-5: 8	4.48 (0.25)	1.19 (0.04)	85.6 (0.4)	34.1 (0.4)	6.16 (0.24)	4
07: 13-11: 10	4.93 (0.23)	1.18 (0.04)	84.1 (1.0)	30.4 (2.4)	4.16 (0.38)	13
07: 1-5: 5	4.76 (0.30)	1.16 (0.05)	85.0 (0.7)	31.5 (2.4)	4.65 (0.49)	13
07: 13-11: 7	4.68 (0.28)	1.16 (0.05)	83.6 (0.9)	29.2 (2.2)	4.56 (0.75)	19
07: 1-2: 5	4.50 (0.21)	1.13 (0.04)	84.7 (0.7)	30.9 (1.5)	4.92 (0.74)	6
07: 1-2: 9	4.62 (0.24)	1.12 (0.03)	84.9 (0.4)	32.7 (0.8)	6.00 (0.09)	4
06: 104-3: 1	4.88 (0.35)	1.12 (0.03)	84.5 (0.8)	31.7 (1.2)	6.64 (1.45)	16
Rob-2	4.77 (0.63)	1.09 (0.05)	84.0 (1.0)	29.6 (1.3)	4.90 (0.32)	4
06: 104-3: 10	4.79 (0.16)	1.09 (0.03)	83.4 (0.7)	28.7 (1.9)	5.94 (1.22)	8
06: 104-3: 2	4.54 (0.38)	1.07 (0.01)	81.6 (0.9)	25.4 (1.4)	3.97 (0.46)	7
CV Parents	4.90 (0.27)	1.08 (0.03)	83.0 (0.8)	28.3 (1.2)	5.23 (1.35)	9

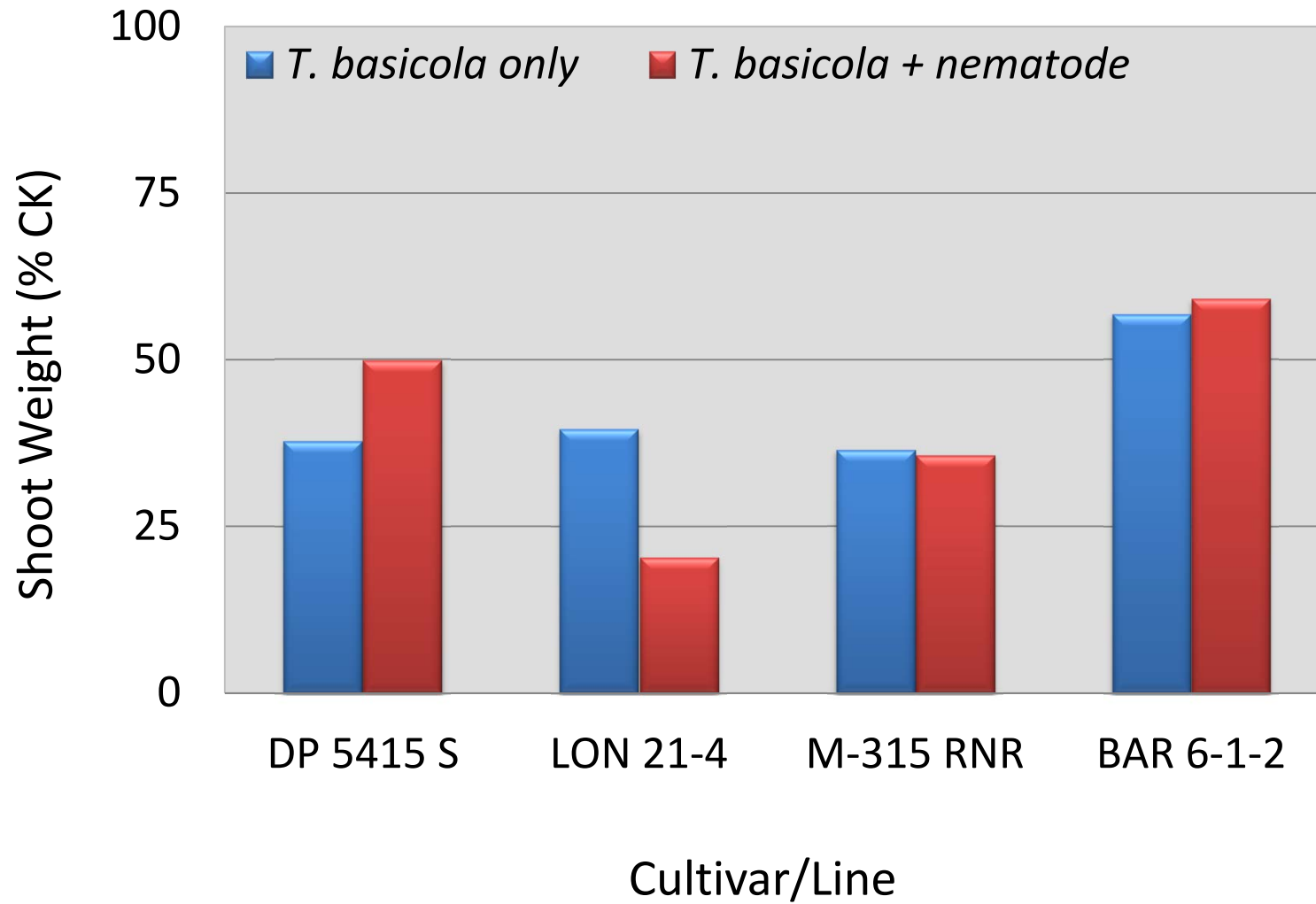
## RELATIONSHIPS BETWEEN RESISTANCE MARKERS AND FIBER QUALITY

Marker Presence	MIC	UHM	UI	STR	ELO	No. Lines
CIR 316_202 ( <i>rkn1</i> )						
-	4.72(0.16)	1.15 (0.05)	84.4 (0.7)	31.0 (1.5)	5.32 (1.01)	10
+	4.79 (0.27)	1.14 (0.04)	84.2 (0.9)	30.5 (1.9)	5.02 (1.28)	16
BNL 3279_105 / BNL 1551_162 / BNL 569_131 ( <i>Ren2 / Ren1 / Ren3</i> )						
+++	4.88 (0.30)	1.17 (0.04)	84.5 (1.1)	31.1 (2.0)	4.46 (0.78)	14
++-	4.68 (0.34)	1.15 (0.05)	84.4 (0.9)	31.2 (2.2)	5.41 (1.41)	42
+ - +	4.69 (0.17)	1.10 (0.04)	83.7 (1.0)	29.2 (2.3)	4.93 (0.31)	7
+ - -	4.84 (0.26)	1.12 (0.05)	84.0 (1.0)	29.6 (2.1)	5.30 (1.05)	25
- - -	4.90 (0.27)	1.08 (0.03)	83.0 (0.8)	28.3 (1.2)	5.23 (1.35)	9

**RESISTANCE OF LONREN 21-4 AND BAR 6-1-2  
TO *Thielaviopsis basicola* AND *Rhizoctonia solani***



## EFFECTS OF RENIFORM NEMATODE ON RESISTANCE OF LONREN 21-4 AND BAR 6-1-2 TO *Thielaviopsis basicola*





## Conclusions

- ❖ Genes associated with the BNL 3279\_105 marker from GB 713 have profound effects on plant vigor and yield in Upland cotton and should have widespread application in breeding.
- ❖ Something more than resistance to reniform nematode appears to be involved, since plants with the marker also exhibit increased resistance to fungal pathogens and heat stress.