

**Accomplishments of a
10-Year Initiative
to Develop
Host Plant Resistance to
Root-Knot and Reniform
Nematodes
in Cotton 2003 - 2013**



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Nematode Management

Rotation – Driven by Crop Prices

Nematicides – Aldicarb Unavailable

Resistant Cultivars

Root Knot – before 2014 partial
resistance

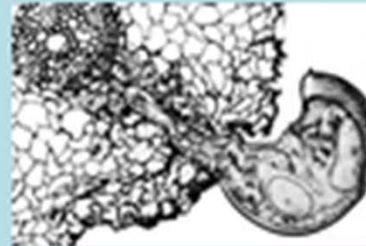
Reniform - none



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Cotton Incorporated Host Plant Resistance Initiative Situation: 2003

- Root-Knot Nematode
 - Germplasm
'Shepard Source'
 - Variety – LA 887
- Reniform
 - ZERO



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Cotton Incorporated Sponsored Meeting “Breeding Cotton for Resistance to Nematodes” August 20, 2003 – Austin Texas

Objectives

1. Identify, characterize, and locate genes to develop germplasm with host plant resistance against root-knot (*Meloidogyne incognita*) and reniform (*Rotylenchulus reniformis*) nematodes.
2. Identify the technologies needed to conduct efficient breeding programs and provide them.
3. Address the task of transferring germplasm and necessary breeding technologies to commercial planting seed companies.



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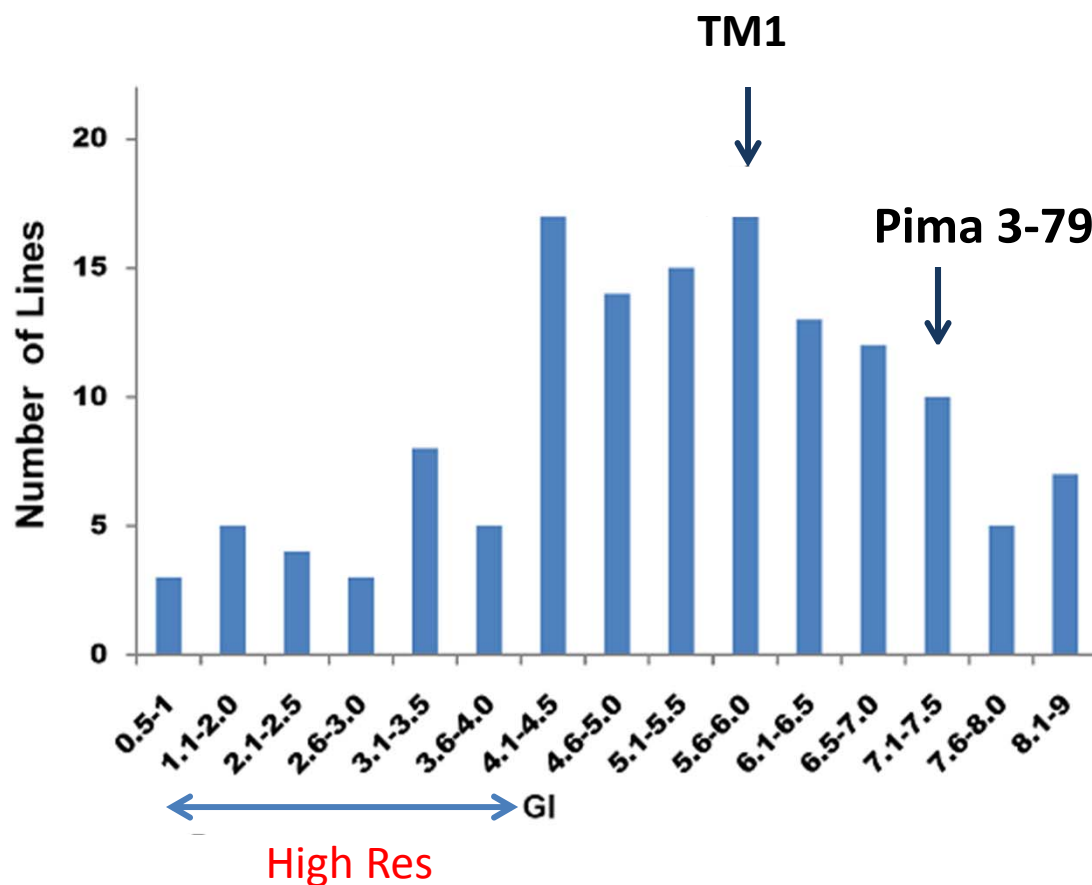
Genetics of Root-Knot Nematode Resistance

Population	Genes/QTL	Markers	Researcher
NemX x SJ-2	rkn-1 – ch. 11 (recessive)	CIR-316 BNL 1066	Roberts Roberts
M 125 x S-6	<i>Mi</i> -A03 – ch. 11 (dominant)	CIR-316 CIR-069	Chee Chee
M 240 x STV 213	QTL – ch. 11	CIR-316 BNL 1231	Jenkins Jenkins
M 240 x STV 213	QTL ch 14	BNL 3545 BNL 3661 BNL 3664	Jenkins Jenkins Jenkins



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Extreme phenotypes of transgressive segregants outside parent range in RIL TM1 x Pima 3-79



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Segregants from the Population TM-1 x Pima 3-79

**TM-1
Sus.**



X

**Pima 3-79
Sus.**



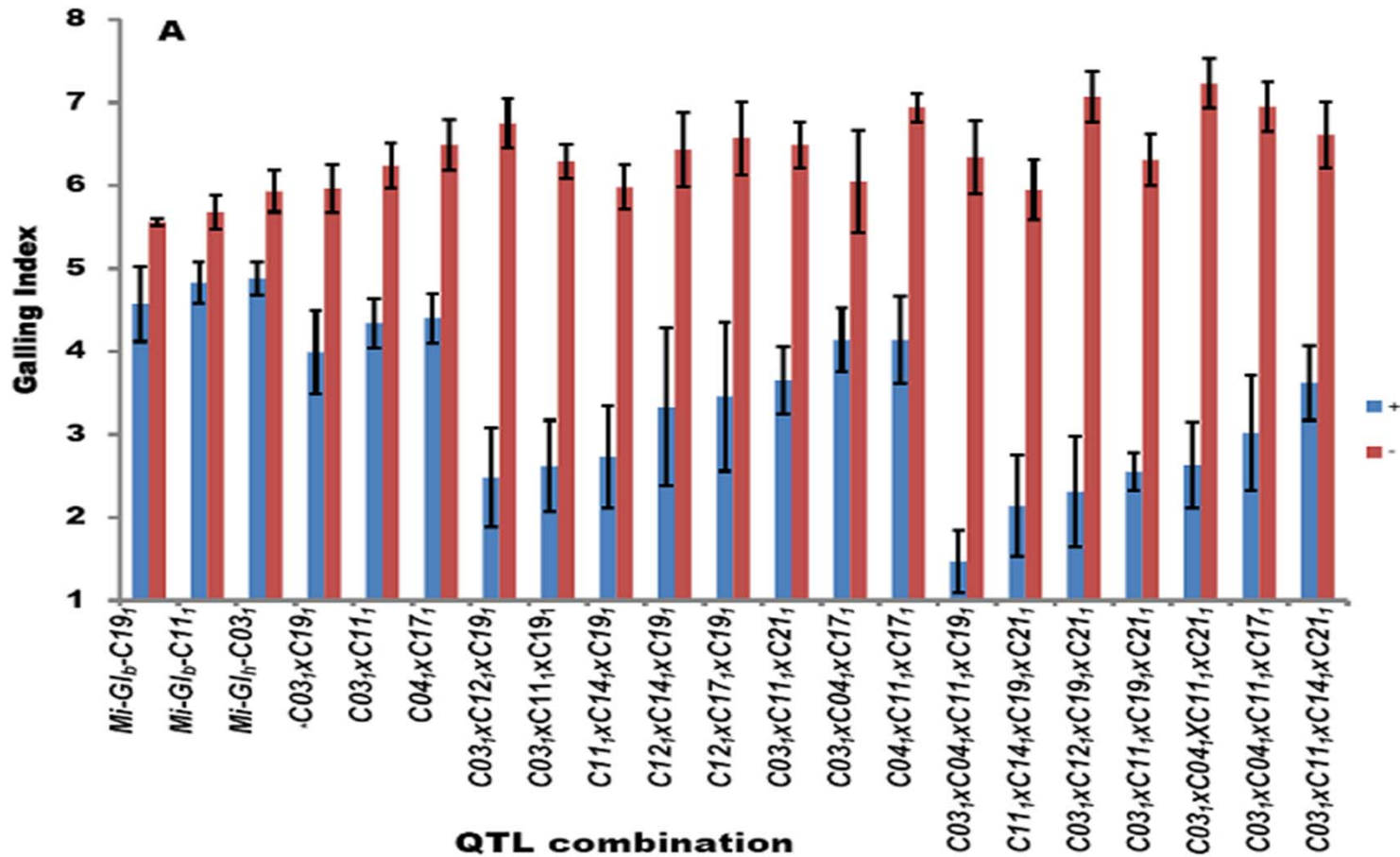
**RIL Progeny
Highly Res.**



**RIL progeny
Highly Sus.**



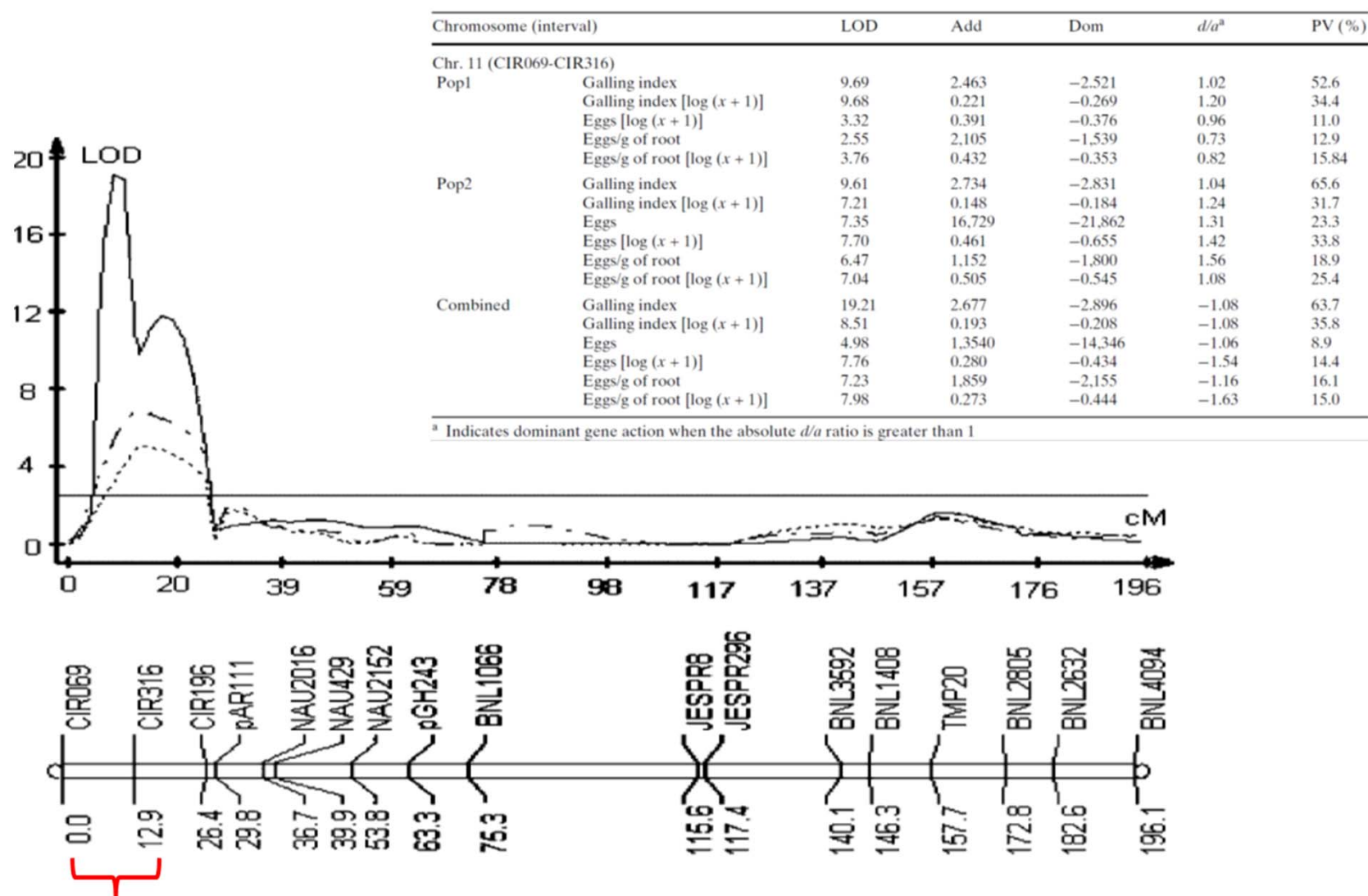
Comparison of lines with/without combinations of 2 to 4 QTLs showed reduction > 50% in both Gall Index (GI) and Egg production



C03 x C04 x C11 x C19 GI 1.7
TM1 x P3-79 x P3-79 x TM1



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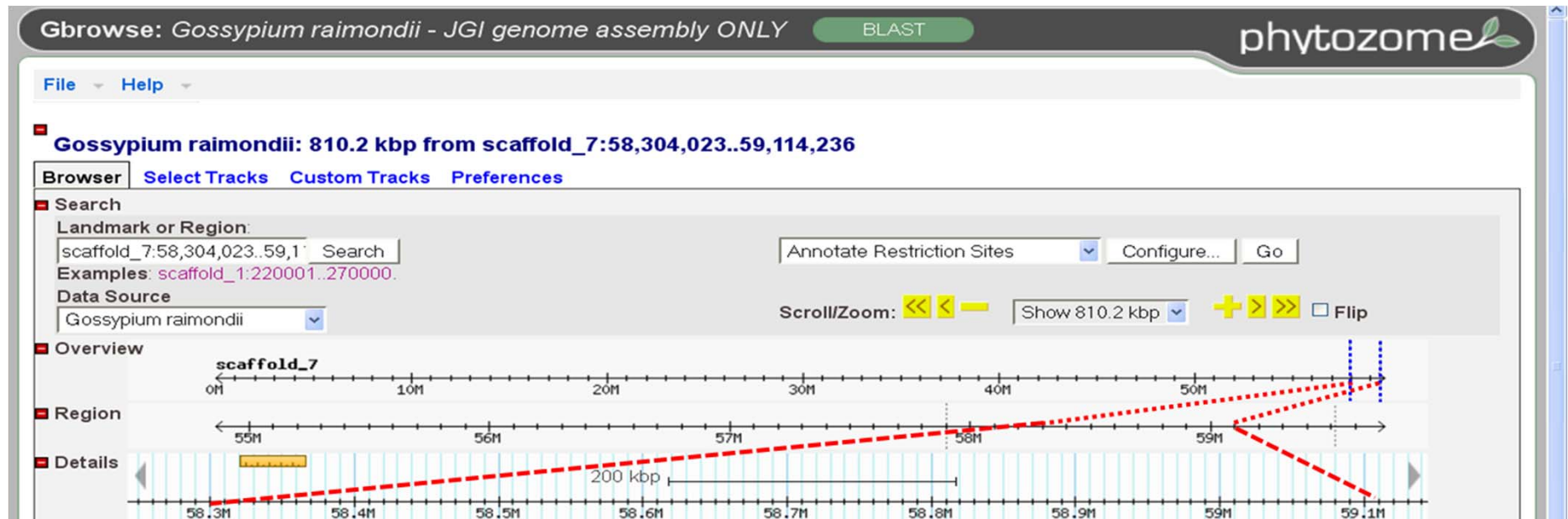


RKN resistance QTL



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Identifying the Resistance-Gene Rich Region of Chromosome 11



CIR316

CIR069

810 Kbp



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New Sources of Root-Knot Nematode Resistance

- **Dr. Jim Starr showed that five primitive race stocks from Mexico had good to excellent, heritable root-knot nematode resistance.**
- **Markers associated with the resistance in other lines were not associated in the newly evaluated lines.**

**Starr et al. 2010. J. of Nematology
42:352-358.**



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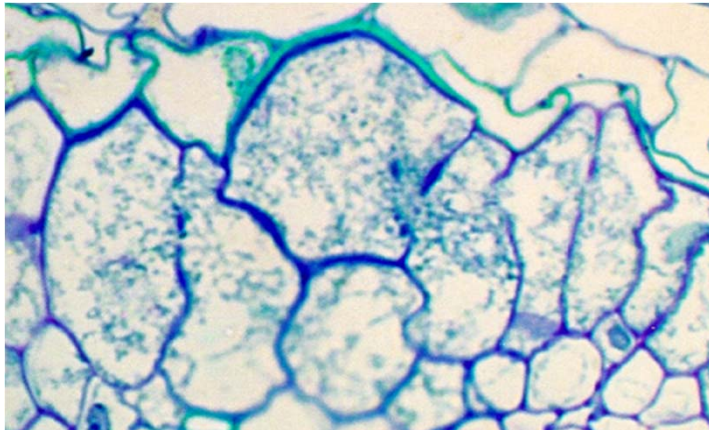
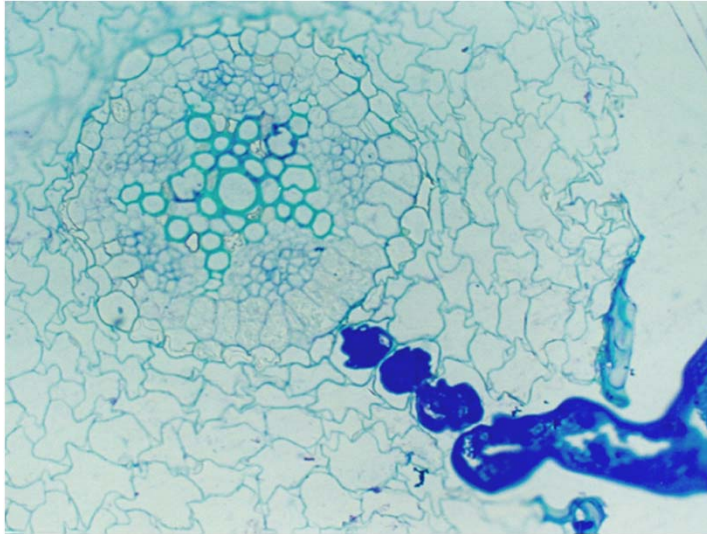
Reniform Nematode Resistance (2003)

Gossypium hirsutum (AADD) – none
G. barbadense (AADD) - primitive
G. arboreum (A) – little known
G. armorianum (D) - little known
G. longicalyx – virtual immunity

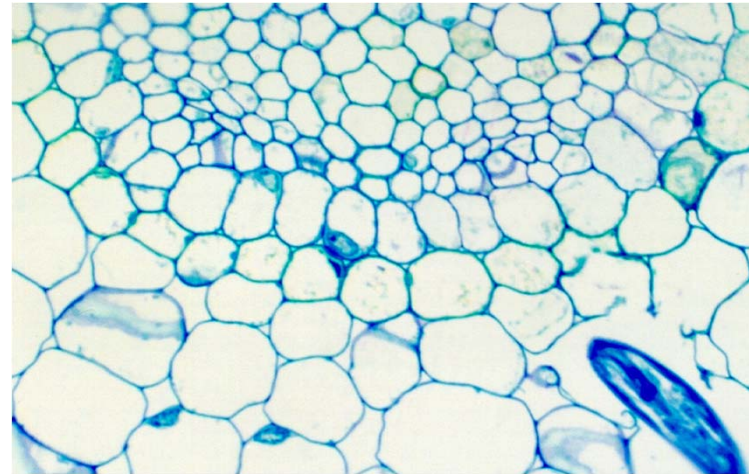
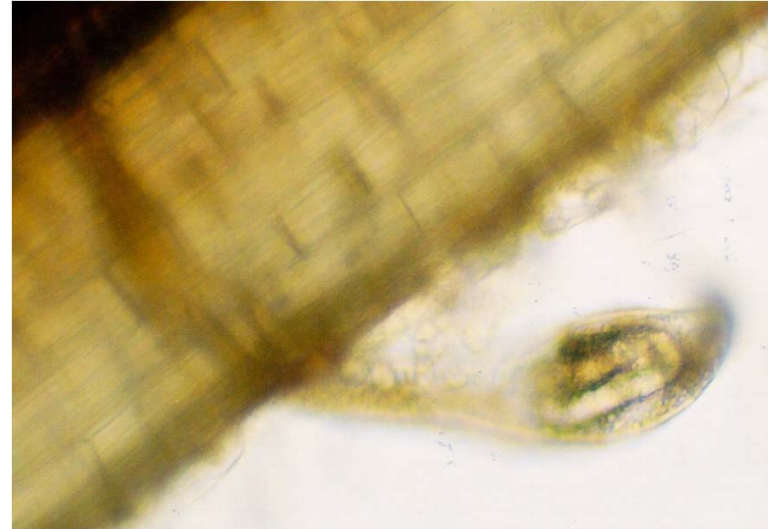


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SUSCEPTIBLE



RESISTANT



Agudelo et al. 2005. Journal of Nematology 37:444-447.

Triple Species Hybrids

**Gossypium hirsutum x G. longicalyx
x G. armorianum**

AD x F = (FAD)² x D = FADD

G. hirsutum x G. herbaceum x G. longicalyx

AD x A (AAD)² x F = AADF

Robinson et al. 2007. Crop Sci. 47: 1865-1877



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Belle Mina, July 14, 2011 (58 days after planting)



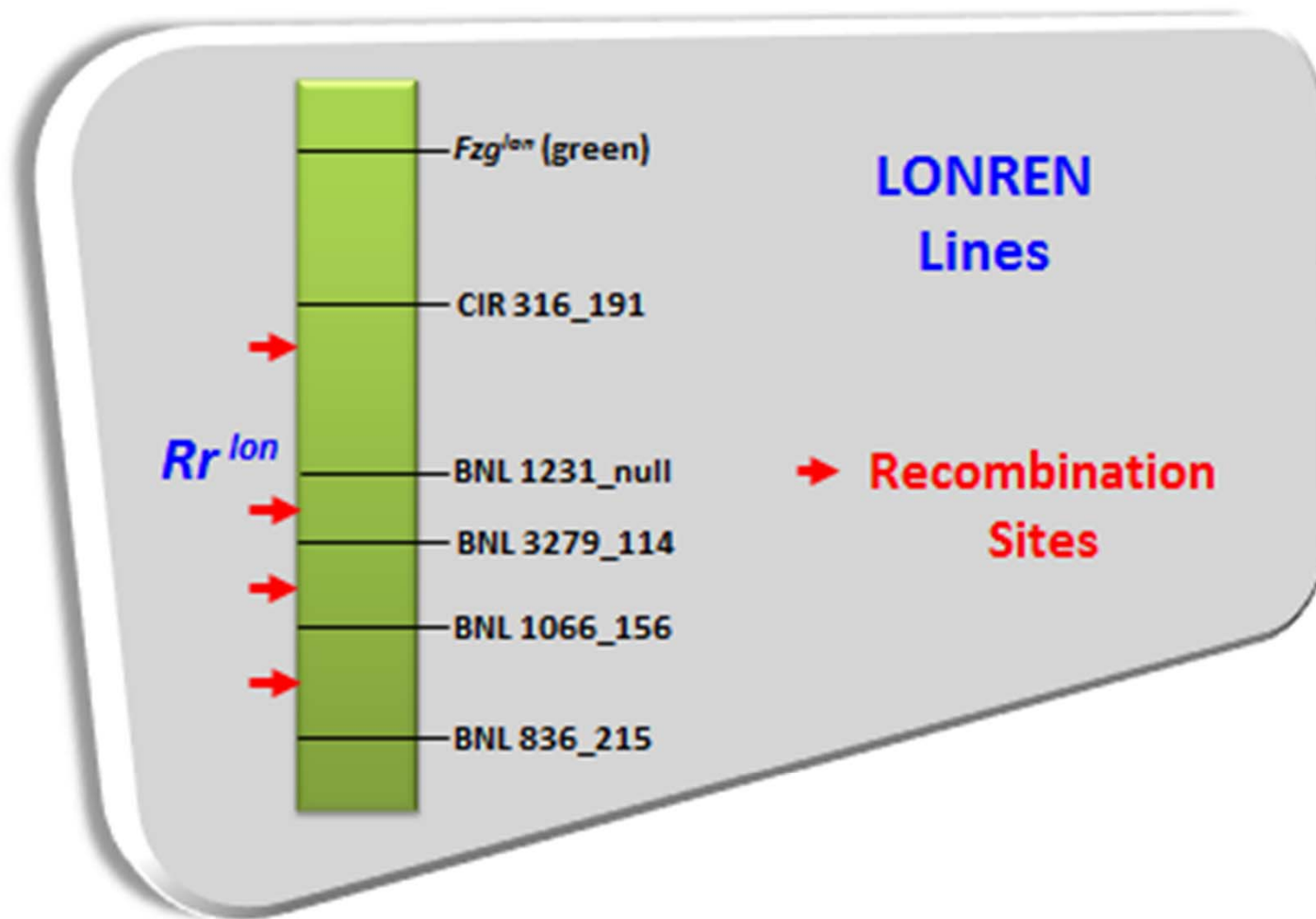
plot 301 – BARBREN-713

plot 302 - LONREN 21-4



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MARKERS ON INTROGRESSION SEGMENTS FROM *G. longicalyx*



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Triple Species Hybrids

**Gossypium arboreum x
(G. hirsutum x G. aridum)²**

Romano et al. 2009. TAG 120: 139-150

Fang & Stetina . 2011. Plt. Breeding 130: 673-678



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Reniform Nematode Resistance from GB 713

2004. Robinson et al. report that *Gossypium barbadense* 713 suppresses reniform nematode production

2010. Gutierrez et al. conclude that resistance in GB 713 is due to 3 QTLs.

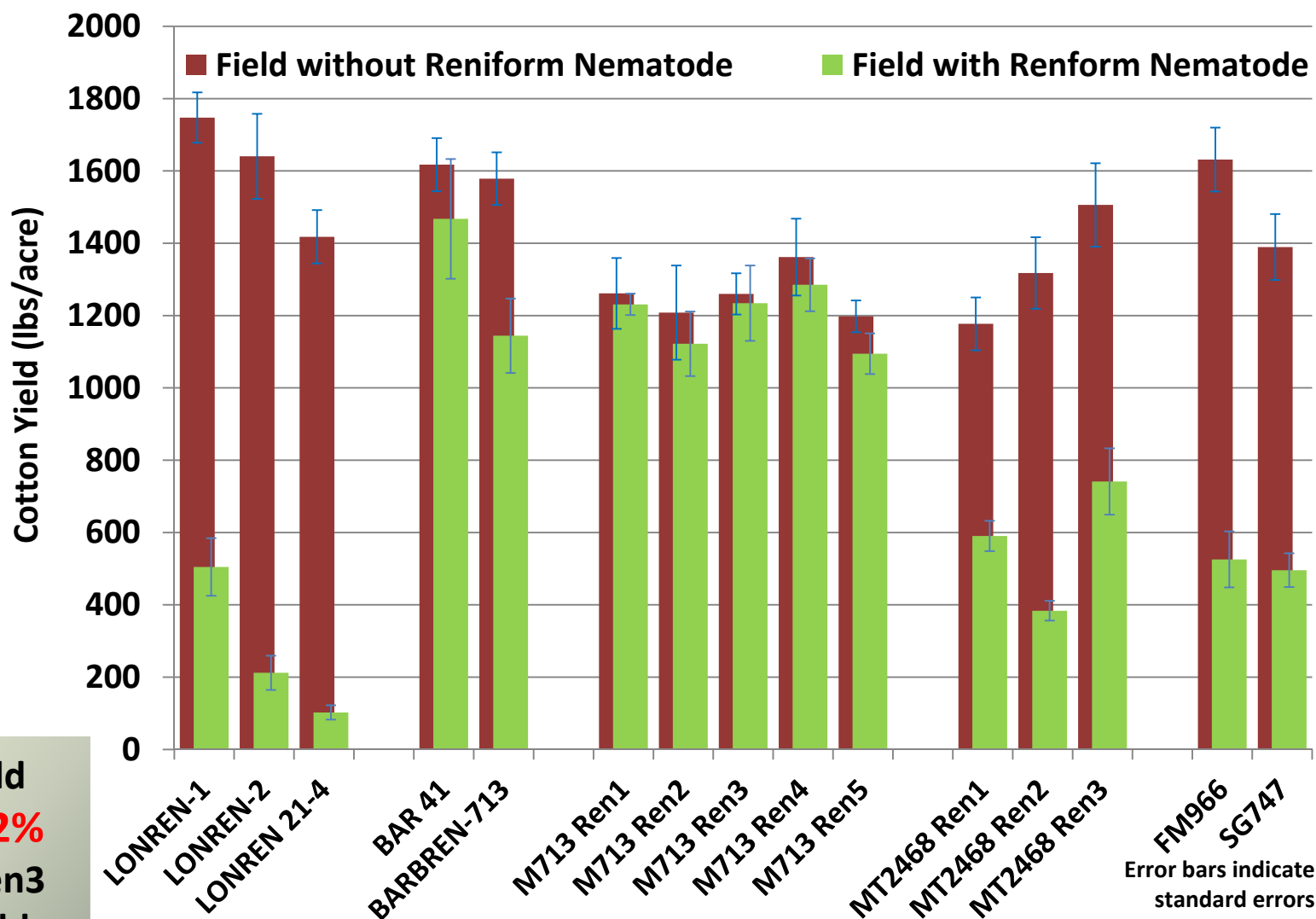
2012. Release Notice for M713 (5 lines).

2012. Release Notice for Barbren (1 line)



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Yields



Lowest Yield
Reduction: **2%**
for M713 Ren3
Highest Yield
Reduction: **93%**
LONREN 21-4
Yield Reduction
for BAR 41: **9%**

Highest yield: 1748 lbs/acre LONREN-1 on the no RN field
Lowest yield: 102 lbs/acre LONREN 21-4 on the with RN field

Cotton Resistance to Nematodes

Situation at start of 2014

Root Knot

High Level Resistance is at least a two-gene system – ch. 11 + chs. 7, 14, 21 – possibly others; resistance is epistatic

Delta & Pineland and PhytoGen launch resistant cultivars in 2014

Reniform

Public releases with moderate resistance from
G. hirsutum MT2468

Public releases with high-level resistance from
G. barbadense – Barbren and M713

Numerous markers publically available for both



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What has been accomplished?

Enabling Technology – Genes Identified,
Inheritance Characterized, Published Markers,
Germplasm Releases.

Information in Public Domain

Incentive for Development

Grower Awareness of Research Progress



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