Breeding for Resistance to SCN in the Midwest

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Overview

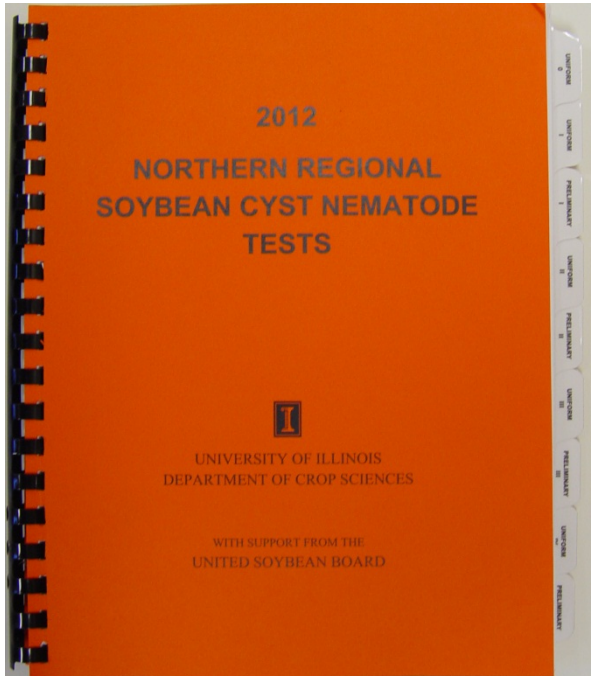
- Background on SCN and resistance in the Midwest.
- SCN Uniform Test results.
- Efforts to utilize new resistance genes.

PI 88788 Resistance

- PI 88788 SCN resistance is overused in the Midwest.
  - > 90 % of SCN resistant cultivars carry resistance from this source.
- SCN isolates have adapted to PI 88788 SCN resistance.
  - 70% of the SCN positive soil samples from Illinois could overcome PI 88788 resistance.
  - Does this mean a looming disaster?

SCN HG Types in Field Locations

- Northern Regional Soybean Cyst Nematode Tests.
  - Managed by Troy Cary with collaboration from breeders throughout the North Central US.
  - Funded by USB.
- SCN egg number and HG type tested from soil samples from each environment.
  - Alison Colgrove, Terry Niblack, and Suzanne Bissonnette.



USB
UNITED SOYBEAN BOARD
Making Your Checkoff Pay Off.

2012 SCN Uniform Test Locations

				Female Index (% of Lee 74)						
	Location	HG Type	Eggs/ 100cc	HG 1 Peking	HG 2 88788	HG 3 90763	HG 4 437654	HG 5 209332	HG 6 89772	HG 7 Cloud
IA	Lawler	2.5.7	680	0	18	0	0	13	0	40
IA	Leighton	2.5.7	400	1	20	0	0	24	1	29
IA	Mason City	2.5.7	400	3	24	0	0	27	0	33
IA	Muscatine	2	320	0	11	0	0	8	0	9
IA	Nevada	1.2.5.6.7	440	17	23	0	0	17	13	29
IA	Urbana	7	520	0	3	0	0	1	0	13
IL	Arthur	2.5.7	440	2	31	0	0	21	0	53
IL	DeKalb	1.2.5.7	920	11	11	0	0	12	0	11
KS	Manhattan	2.7	600	0	19	0	0	8	0	18
MI	Decatur	2.5.7	6560	5	16	0	0	13	2	25
MN	Gaylord	2.5.7	280	0	16	0	0	25	0	34
MN	Lamberton	2.5.7	1640	1	25	0	0	34	0	44
MN	Rosemount	2.5.7	1440	0	14	0	0	17	0	41
MN	Waseca	2.7	280	1	10	0	0	8	1	13
MO	Clarkton(sand)	1.2.5.6.7	280	33	41	3	0	31	10	37
MO	Columbia2	2.5.7	360	2	16	0	0	14	4	17
ND	Dwight	7	2120	0	5	0	0	7	0	30
ON	Chatham	2.5.7	3860	0	22	0	0	17	0	35
ON	Harrow	2.5.7	1680	3	15	0	0	22	0	38
SD	Beresford1	0	200	0	1	0	0	1	0	10

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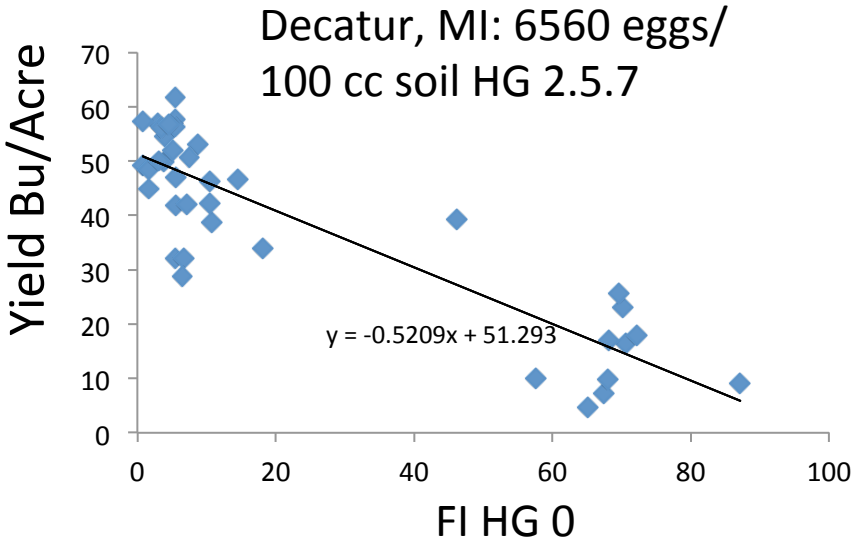
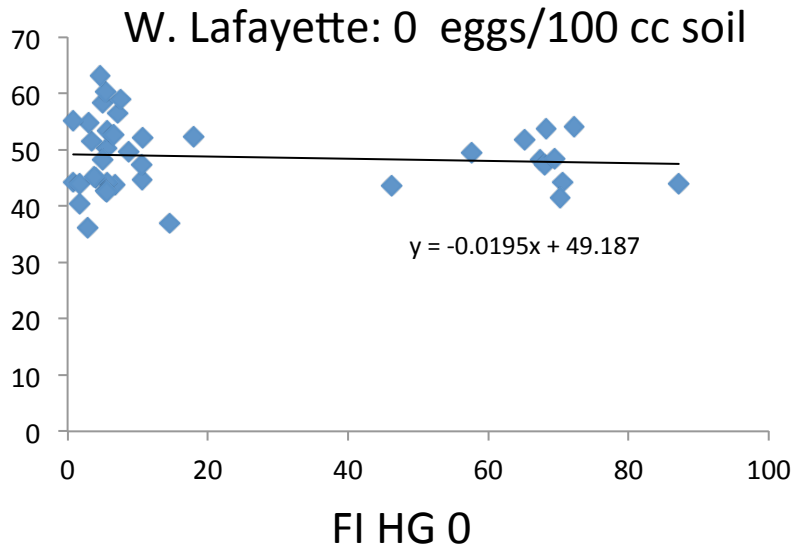
Mean FI on PI 88788 for HG 2 isolates is 19

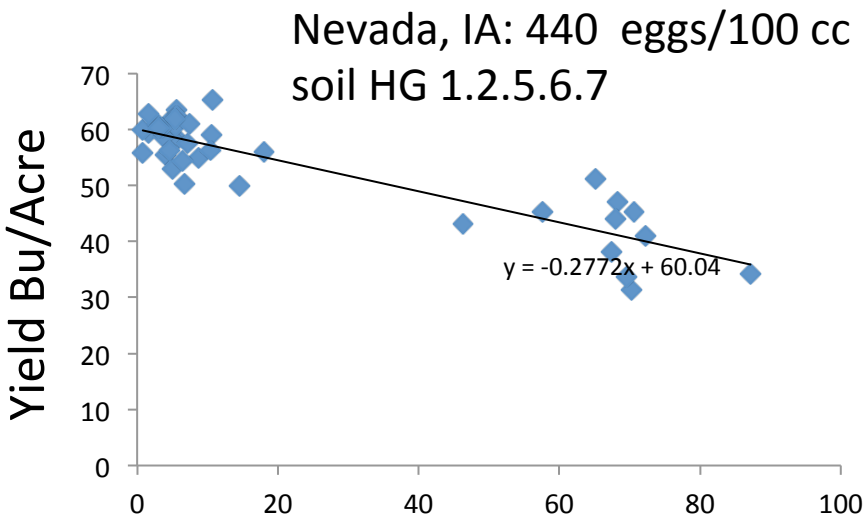
Impact of SCN Resistance on Yield

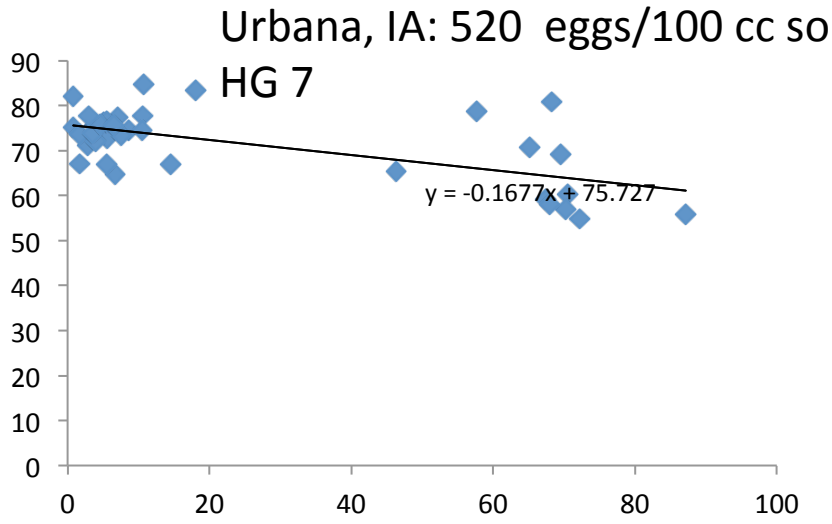
- Northern Regional SCN Tests.
- Yields of MG II prelim test.
  - 39 entries.
- Relative yield trends for genotypes that are SCN susceptible and with resistance from either PI 88788 and PI 437654 (Hartwig).
  - 49 MG III environments from 2010-2012.
  - 70 MG IV environments from 2008-2012.

Relationship Between Resistance (GH HG 0) and Yield (Field) in MG II Test









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Average is 1171 eggs / 100 ml soil

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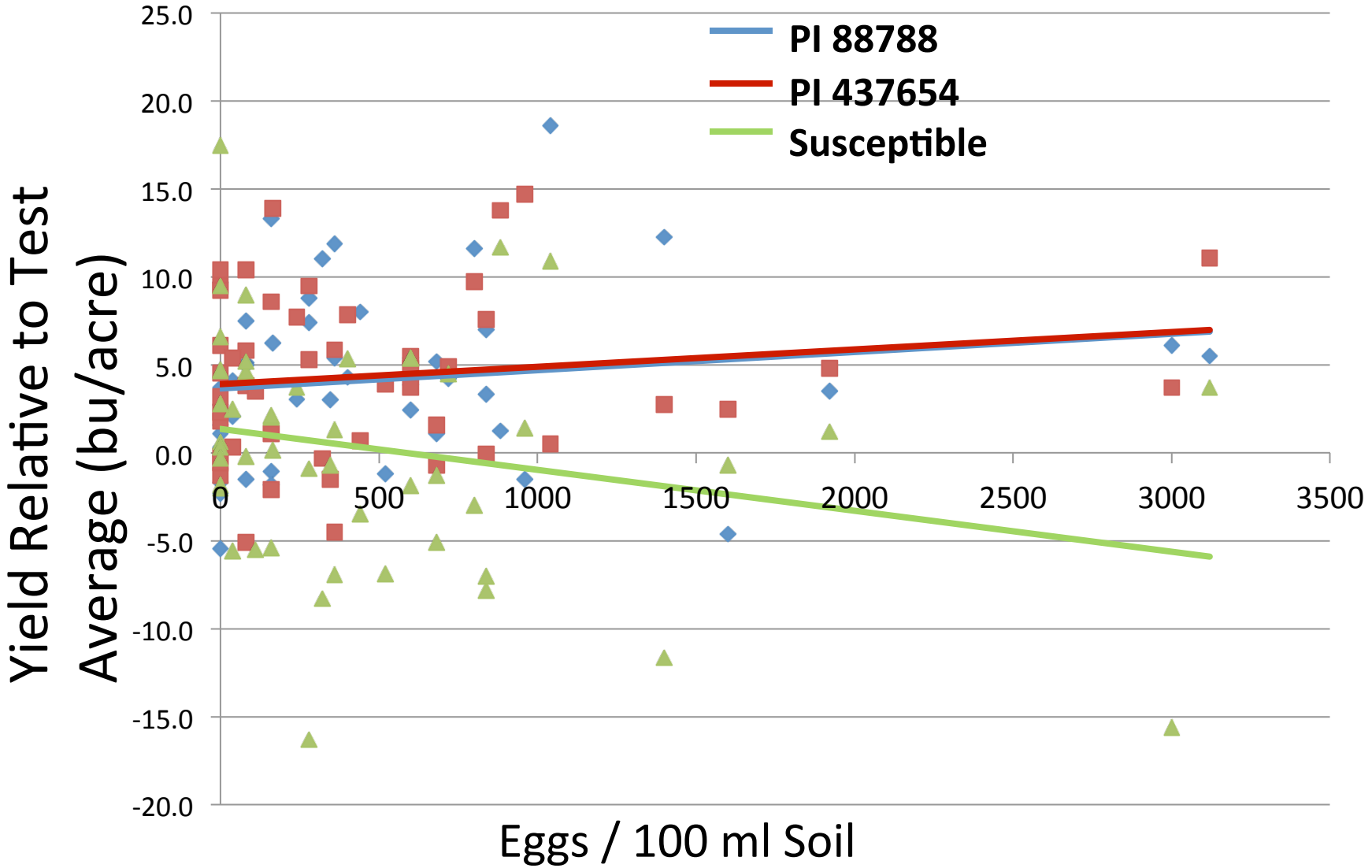
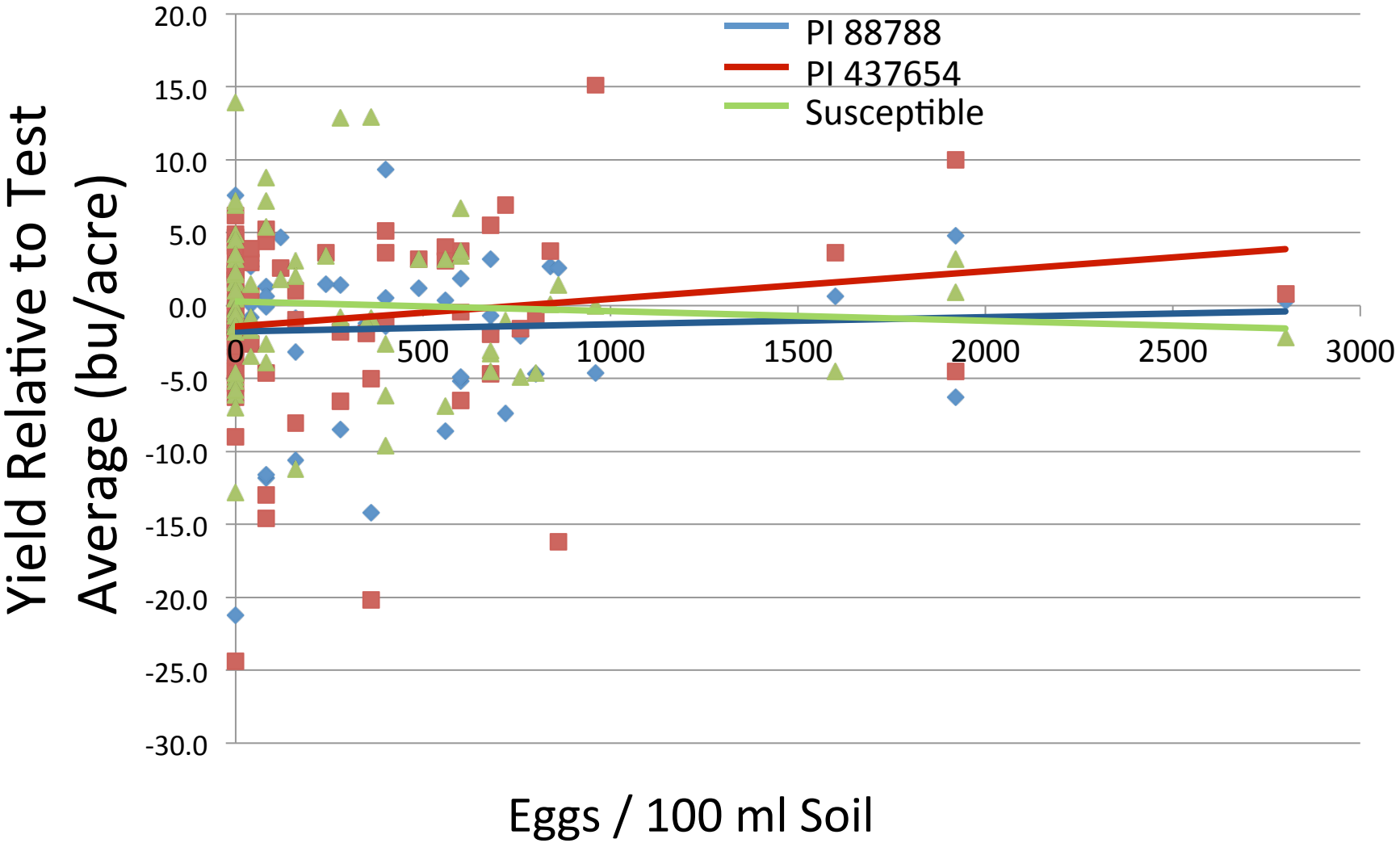
Yield of MG III Lines Relative to Test Mean



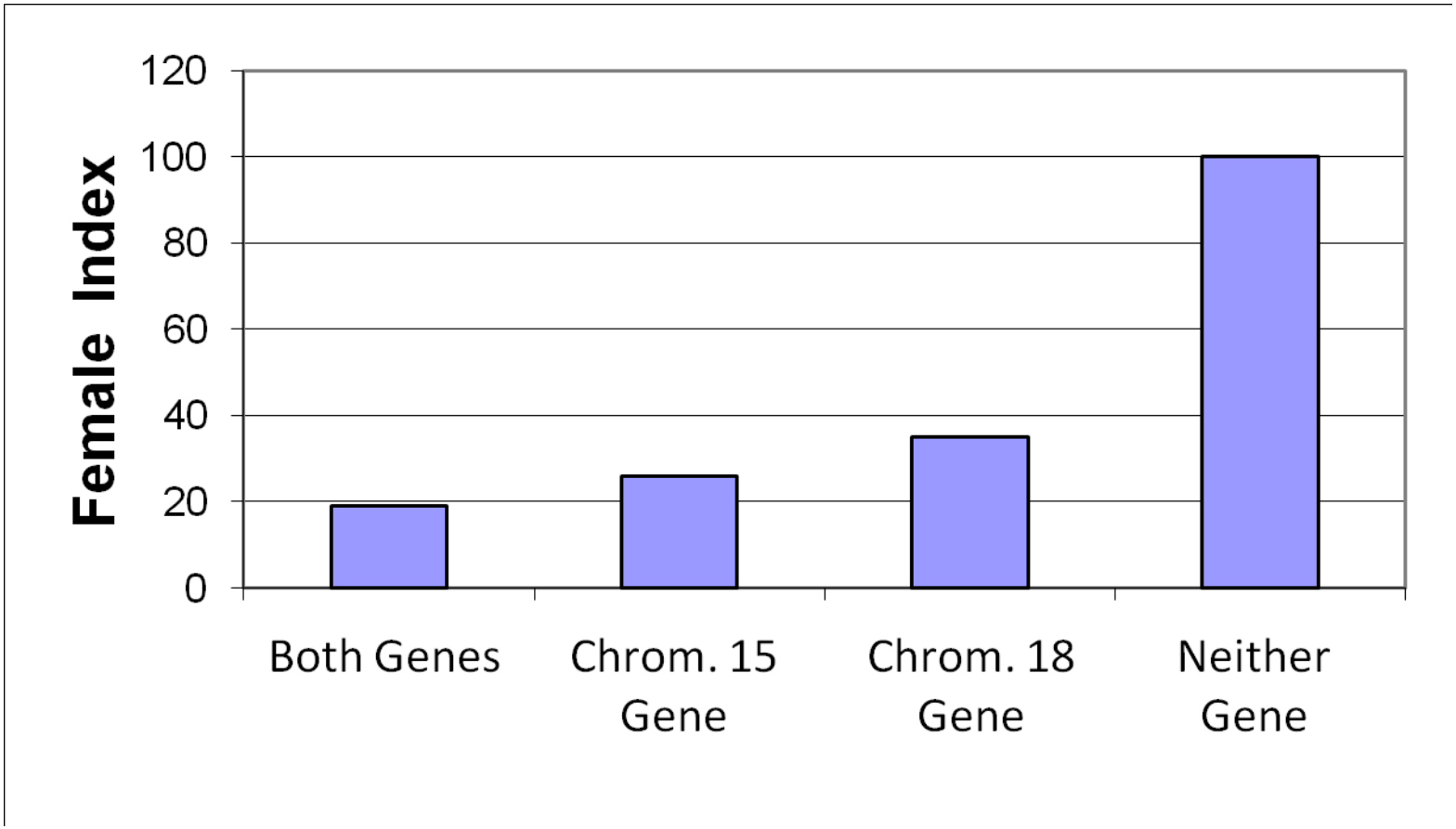
Yield of MG IV Lines Relative to Test Mean



New Sources of Resistance

- Need new sources of resistance genes.
- Focus on two resistance QTL from *Glycine soja* PI 468916.
  - cqSCN-006
  - cqSCN-007

Resistance of Lines in a BC4 Population Segregating for *G. soja* QTL (HG Type 0)



Effects of Resistance Gene Combinations (Prakash Arelli)

	SCN Isolate				
	LY1	R1 (PA1)	R2 (PA2)	R3 (PA3)	R5 (PA5)
2 *G. soja*	71	16	54	27	40
PI88788 (LD00-3309)	48	30	76	28	42
2 *G. soja* + 88788	29	16	43	4	10

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Fine Mapping *G. soja* QTL
Myungsik Kim

- cqSCN-006 on chr 15 (LG E).
  - Tested 2,898 backcross plant tested with flanking markers.
  - Progeny from 20 recombinant plants tested for SCN resistance and genetic markers
- cqSCN-007 on chr 18 (LG G).
  - Tested 1,668 backcross plants with flanking markers
  - Progeny from 18 recombinant plants tested for SCN resistance and genetic markers.

Chromosome 18 QTL

Marker†	Position on Chr. 18 (bp)‡	07Hill-986-5	07Hill-986-6	07Hill-986-1	07Hill-986-8	07Hill-986-72	07Hill-986-86	07Hill-984-5	07Hill-986-19	07Hill-986-73	07Hill-986-14	07Hill-986-20	07Hill-986-57	07Hill-984-2	07Hill-986-35	07Hill-986-46	07Hill-986-75	07Hill-986-76	07Hill-986-38
Satt288	55,407,119	S§	S	S	S	S	S	H	S	S	S	S	S	S	S	S	S	S	S
BARCSOYSSR_18_1551	55,658,334	S	S	S	S	S	S	H	S	S	S	S	S	S	S	S	S	S	S
BARCSOYSSR_18_1570	56,037,903	H	H	H	H	H	H	H	S	H	H	S	S	S	S	S	S	S	S
BARCSOYSSR_18_1588	56,364,465	H	H	H	H	H	H	H	S	H	H	S	S	S	S	S	S	S	S
BARCSOYSSR_18_1593	56,423,682	H	H	H	H	H	H	H	S	H	H	S	S	S	S	S	S	S	H
BARCSOYSSR_18_1600	56,482,347	H	H	H	H	H	H	H	S	H	H	S	S	S	S	S	S	S	H
BARCSOYSSR_18_1603	56,568,347	S	H	H	H	H	H	H	S	H	H	S	S	S	S	S	S	S	H
BARCSOYSSR_18_1605	56,569,542	S	H	H	H	H	H	H	S	H	H	S	S	S	S	S	S	S	H
BARCSOYSSR_18_1614	56,696,421	S	S	H	H	H	H	H	S	H	H	S	S	S	S	S	S	S	H
BARCSOYSSR_18_1626	56,966,941	S	S	H	H	H	H	H	S	H	H	S	S	S	S	S	S	S	H
BARCSOYSSR_18_1631	57,040,422	S	S	S	H	H	H	H	S	H	H	S	S	S	S	S	S	S	H
BARCSOYSSR_18_1641	57,134,393	S	S	S	H	H	H	H	S	H	H	S	S	S	S	S	S	S	H
BARCSOYSSR_18_1645	57,182,271	S	S	S	H	H	H	H	S	H	H	S	S	S	S	S	S	H	H
BARCSOYSSR_18_1661	57,386,156	S	S	S	S	S	S	H	S	H	H	S	S	S	S	S	S	H	H
BARCSOYSSR_18_1664	57,428,776	S	S	S	S	S	S	H	S	H	H	S	S	S	S	S	H	H	H
BARCSOYSSR_18_1665	57,436,776	S	S	S	S	S	S	H	S	H	H	S	S	S	S	S	H	H	H
BARCSOYSSR_18_1669	57,490,745	S	S	S	S	S	S	H	S	H	H	S	S	S	S	H	H	H	H
BARCSOYSSR_18_1670	57,505,749	S	S	S	S	S	S	H	S	H	H	S	S	S	H	H	H	H	H
BARCSOYSSR_18_1674	57,605,344	S	S	S	S	S	S	H	S	H	H	S	S	S	H	H	H	H	H
BARCSOYSSR_18_1675	57,637,254	S	S	S	S	S	S	S	H	H	H	S	S	S	H	H	H	H	H
BARCSOYSSR_18_1676	57,682,667	S	S	S	S	S	S	S	H	H	H	S	H	H	H	H	H	H	H
BARCSOYSSR_18_1677	57,689,794	S	S	S	S	S	S	S	H	H	H	S	H	H	H	H	H	H	H
BARCSOYSSR_18_1678	57,742,177	S	S	S	S	S	S	S	H	S	H	S	H	H	H	H	H	H	H
BARCSOYSSR_18_1690	57,979,439	S	S	S	S	S	S	S	H	S	H	S	H	H	H	H	H	H	H
BARCSOYSSR_18_1704	58,095,287	S	S	S	S	S	S	S	H	S	S	H	H	H	H	H	H	H	H
Satt472	58,136,286	S	S	S	S	S	S	S	H	S	S	H	H	H	H	H	H	H	H

Chromosome 18 QTL

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Satt288	55,407,119	S§	S	S	S	S	S	H	S	S	S	S	S	S	**S**	S	S	S	S
BARCSOYSSR_18_1551	55,658,334	S	S	S	S	S	S	H	S	S	S	S	S	S	**S**	S	S	S	S
BARCSOYSSR_18_1570	56,037,903	H	H	H	H	H	H	H	S	H	H	S	S	S	**S**	S	S	S	S
BARCSOYSSR_18_1588	56,364,465	H	H	H	H	H	H	H	S	H	H	S	S	S	**S**	S	S	S	S
BARCSOYSSR_18_1593	56,423,682	H	H	H	H	H	H	H	S	H	H	S	S	S	**S**	S	S	S	H
BARCSOYSSR_18_1600	56,482,347	H	H	H	H	H	H	H	S	H	H	S	S	S	**S**	S	S	S	H
BARCSOYSSR_18_1603	56,568,347	S	H	H	H	H	H	H	S	H	H	S	S	S	**S**	S	S	S	H
BARCSOYSSR_18_1605	56,569,542	S	H	H	H	H	H	H	S	H	H	S	S	S	**S**	S	S	S	H
BARCSOYSSR_18_1614	56,696,421	S	S	H	H	H	H	H	S	H	H	S	S	S	**S**	S	S	S	H
BARCSOYSSR_18_1626	56,966,941	S	S	H	H	H	H	H	S	H	H	S	S	S	**S**	S	S	S	H
BARCSOYSSR_18_1631	57,040,422	S	S	S	H	H	H	H	S	H	H	S	S	S	**S**	S	S	S	H
BARCSOYSSR_18_1641	57,134,393	S	S	S	H	H	H	H	S	H	H	S	S	S	**S**	S	S	S	H
BARCSOYSSR_18_1645	57,182,271	S	S	S	H	H	H	H	S	H	H	S	S	S	**S**	S	S	H	H
BARCSOYSSR_18_1661	57,386,156	S	S	S	S	S	S	H	S	H	H	S	S	S	**S**	S	S	H	H
BARCSOYSSR_18_1664	57,428,776	S	S	S	S	S	S	H	S	H	H	S	S	S	**S**	S	H	H	H
BARCSOYSSR_18_1665	57,436,776	S	S	S	S	S	S	H	S	H	H	S	S	S	**S**	S	H	H	H
BARCSOYSSR_18_1669	57,490,745	S	S	S	S	S	S	H	S	H	H	S	S	S	**S**	H	H	H	H
BARCSOYSSR_18_1670	57,505,749	S	S	S	S	S	S	H	S	H	H	S	S	S	**H**	H	H	H	H
BARCSOYSSR_18_1674	57,605,344	S	S	S	S	S	S	H	S	H	H	S	S	S	**H**	H	H	H	H
BARCSOYSSR_18_1675	57,637,254	S	S	S	S	S	S	S	H	H	H	S	S	S	**H**	H	H	H	H
BARCSOYSSR_18_1676	57,682,667	S	S	S	S	S	S	S	H	H	H	S	H	H	**H**	H	H	H	H
BARCSOYSSR_18_1677	57,689,794	S	S	S	S	S	S	S	H	H	H	S	H	H	**H**	H	H	H	H
BARCSOYSSR_18_1678	57,742,177	S	S	S	S	S	S	S	H	S	H	S	H	H	**H**	H	H	H	H
BARCSOYSSR_18_1690	57,979,439	S	S	S	S	S	S	S	H	S	H	S	H	H	**H**	H	H	H	H
BARCSOYSSR_18_1704	58,095,287	S	S	S	S	S	S	S	H	S	S	H	H	H	**H**	H	H	H	H
Satt472	58,136,286	S	S	S	S	S	S	S	H	S	S	H	H	H	**H**	H	H	H	H

Chromosome 18 QTL

Marker†	Position on Chr. 18 (bp)‡	07Hill-986-5	07Hill-986-6										07Hill-986-57	07Hill-984-2	**07Hill-986-35**	07Hill-986-46	07Hill-986-75	07Hill-986-76	07Hill-986-38
Satt288	55,407,119	S§	S										S	S	**S**	S	S	S	S
BARCSOYSSR_18_1551	55,658,334	S	S										S	S	**S**	S	S	S	S
BARCSOYSSR_18_1570	56,037,903	H	H										S	S	**S**	S	S	S	S
BARCSOYSSR_18_1588	56,364,465	H	H										S	S	**S**	S	S	S	S
BARCSOYSSR_18_1593	56,423,682	H	H										S	S	**S**	S	S	S	H
BARCSOYSSR_18_1600	56,482,347	H	H										S	S	**S**	S	S	S	H
BARCSOYSSR_18_1603	56,568,347	S	H										S	S	**S**	S	S	S	H
BARCSOYSSR_18_1605	56,569,542	S	H										S	S	**S**	S	S	S	H
BARCSOYSSR_18_1614	56,696,421	S	S										S	S	**S**	S	S	S	H
BARCSOYSSR_18_1626	56,966,941	S	S										S	S	**S**	S	S	S	H
BARCSOYSSR_18_1631	57,040,422	S	S										S	S	**S**	S	S	S	H
BARCSOYSSR_18_1641	57,134,393	S	S										S	S	**S**	S	S	S	H
BARCSOYSSR_18_1645	57,182,271	S	S										S	S	**S**	S	S	H	H
BARCSOYSSR_18_1661	57,386,156	S	S										S	S	**S**	S	S	H	H
BARCSOYSSR_18_1664	57,428,776	S	S										S	S	**S**	S	H	H	H
BARCSOYSSR_18_1665	57,436,776	S	S										S	S	**S**	S	H	H	H
BARCSOYSSR_18_1669	57,490,745	S	S										S	S	**S**	H	H	H	H
BARCSOYSSR_18_1670	57,505,749	S	S										S	S	**H**	H	H	H	H
BARCSOYSSR_18_1674	57,605,344	S	S										S	S	**H**	H	H	H	H
BARCSOYSSR_18_1675	57,637,254	S	S										S	S	**H**	H	H	H	H
BARCSOYSSR_18_1676	57,682,667	S	S	S	S	S	S	S	H	H	H	S	H	H	**H**	H	H	H	H
BARCSOYSSR_18_1677	57,689,794	S	S	S	S	S	S	S	H	H	H	S	H	H	**H**	H	H	H	H
BARCSOYSSR_18_1678	57,742,177	S	S	S	S	S	S	S	H	S	H	S	H	H	**H**	H	H	H	H
BARCSOYSSR_18_1690	57,979,439	S	S	S	S	S	S	S	H	S	H	S	H	H	**H**	H	H	H	H
BARCSOYSSR_18_1704	58,095,287	S	S	S	S	S	S	S	H	S	S	H	H	H	**H**	H	H	H	H
Satt472	58,136,286	S	S	S	S	S	S	S	H	S	S	H	H	H	**H**	H	H	H	H

Test progeny from selected plant

Chromosome 18 QTL

Marker†	Position on Chr. 18 (bp)‡	07Hill-986-5	07Hill-986-6	07Hill-986-57	07Hill-984-2	**07Hill-986-35**	07Hill-986-46	07Hill-986-75	07Hill-986-76	07Hill-986-38
Satt288	55,407,119	S§	S	S	S	**S**	S	S	S	S
BARCSOYSSR_18_1551	55,658,334	S	S	S	S	**S**	S	S	S	S
BARCSOYSSR_18_1570	56,037,903	H	H	S	S	**S**	S	S	S	S
BARCSOYSSR_18_1626	56,966,941	S	S	S	S	**S**	S	S	S	H
BARCSOYSSR_18_1631	57,040,422	S	S	S	S	**S**	S	S	S	H
BARCSOYSSR_18_1641	57,134,393	S	S	S	S	**S**	S	S	S	H
BARCSOYSSR_18_1645	57,182,271	S	S	S	S	**S**	S	S	H	H
BARCSOYSSR_18_1661	57,386,156	S	S	S	S	**S**	S	S	H	H
BARCSOYSSR_18_1664	57,428,776	S	S	S	S	**S**	S	H	H	H
BARCSOYSSR_18_1665	57,436,776	S	S	S	S	**S**	S	H	H	H
BARCSOYSSR_18_1669	57,490,745	S	S	S	S	**S**	H	H	H	H
BARCSOYSSR_18_1670	57,505,749	S	S	S	S	**H**	H	H	H	H
BARCSOYSSR_18_1674	57,605,344	S	S	S	S	**H**	H	H	H	H
BARCSOYSSR_18_1675	57,637,254	S	S	S	S	**H**	H	H	H	H
BARCSOYSSR_18_1676	57,682,667	S	S	H	H	**H**	H	H	H	H
BARCSOYSSR_18_1677	57,689,794	S	S	H	H	**H**	H	H	H	H
BARCSOYSSR_18_1678	57,742,177	S	S	H	H	**H**	H	H	H	H
BARCSOYSSR_18_1690	57,979,439	S	S	H	H	**H**	H	H	H	H
BARCSOYSSR_18_1704	58,095,287	S	S	H	H	**H**	H	H	H	H
Satt472	58,136,286	S	S	H	H	**H**	H	H	H	H

Test progeny from selected plant

Marker	Resist	Heter	Susc	Prob	R2
Satt472	24	38	40	0.001	0.30

Chromosome 18 QTL

Marker†	Position on Chr. 18 (bp)‡	07Hill-986-5	07Hill-986-6									07Hill-986-57	07Hill-984-2	**07Hill-986-35**	07Hill-986-46	07Hill-986-75	07Hill-986-76	07Hill-986-38
Satt288	55,407,119	S§	S									S	S	**S**	S	S	S	S
BARCSOYSSR_18_1551	55,658,334	S	S									S	S	**S**	S	S	S	S
BARCSOYSSR_18_1570	56,037,903	H	H									S	S	**S**	S	S	S	S
BARCSOYSSR_18_1626	56,966,941	S	S									S	S	**S**	S	S	S	H
BARCSOYSSR_18_1631	57,040,422	S	S									S	S	**S**	S	S	S	H
BARCSOYSSR_18_1641	57,134,393	S	S									S	S	**S**	S	S	S	H
BARCSOYSSR_18_1645	57,182,271	S	S									S	S	**S**	S	S	H	H
BARCSOYSSR_18_1661	57,386,156	S	S									S	S	**S**	S	S	H	H
BARCSOYSSR_18_1664	57,428,776	S	S									S	S		S	H	H	H
BARCSOYSSR_18_1665	57,436,776	S	S									S	S		S	H	H	H
BARCSOYSSR_18_1669	57,490,745	S	S									S	S	S	H	H	H	H
BARCSOYSSR_18_1670	57,505,749	S	S									S	S	**H**	H	H	H	H
BARCSOYSSR_18_1674	57,605,344	S	S									S	S	**H**	H	H	H	H
BARCSOYSSR_18_1675	57,637,254	S	S									S	S	**H**	H	H	H	H
BARCSOYSSR_18_1676	57,682,667	S	S	S	S	S	S	S	H	H	H	S	H	H	**H**	H	H	H	H
BARCSOYSSR_18_1677	57,689,794	S	S	S	S	S	S	S	H	H	H	S	H	H	**H**	H	H	H	H
BARCSOYSSR_18_1678	57,742,177	S	S	S	S	S	S	S	H	S	H	S	H	H	**H**	H	H	H	H
BARCSOYSSR_18_1690	57,979,439	S	S	S	S	S	S	S	H	S	H	S	H	H	**H**	H	H	H	H
BARCSOYSSR_18_1704	58,095,287	S	S	S	S	S	S	S	H	S	S	H	H	H	**H**	H	H	H	H
Satt472	58,136,286	S	S	S	S	S	S	S	H	S	S	H	H	H	**H**	H	H	H	H

Test progeny from selected plant

Marker	Resist	Heter	Susc	Prob	R2
Satt472	24	38	40	0.001	0.30

Chromosome 18 QTL

Marker†	Position on Chr. 18 (bp)‡	07Hill-986-5	07Hill-986-6	07Hill-986-1	07Hill-986-8	07Hill-986-72	07Hill-986-86	07Hill-984-5	07Hill-986-19	07Hill-986-73	07Hill-986-14	07Hill-986-20	07Hill-986-57	07Hill-984-2	07Hill-986-35	07Hill-986-46	07Hill-986-75	07Hill-986-76	07Hill-986-38
Satt288	55,407,119	S§	S	S	S	S	S	H	S	S	S	S	S	S	S	S	S	S	S
BARCSOYSSR_18_1551	55,658,334	S	S	S	S	S	S	H	S	S	S	S	S	S	S	S	S	S	S
BARCSOYSSR_18_1570	56,037,903	H	H	H	H	H	H	H	S	H	H	S	S	S	S	S	S	S	S
BARCSOYSSR_18_1588	56,364,465	H	H	H	H	H	H	H	S	H	H	S	S	S	S	S	S	S	S
BARCSOYSSR_18_1593	56,423,682	H	H	H	H	H	H	H	S	H	H	S	S	S	S	S	S	S	H
BARCSOYSSR_18_1600	56,482,347	H	H	H	H	H	H	H	S	H	H	S	S	S	S	S	S	S	H
BARCSOYSSR_18_1603	56,568,347	S	H	H	H	H	H	H	S	H	H	S	S	S	S	S	S	S	H
BARCSOYSSR_18_1605	56,569,542	S	S	H	H	H	H	H	S	H	H	S	S	S	S	S	S	S	H
BARCSOYSSR_18_1614	56,696,421	S	S	H	H	H	H	H	S	H	H	S	S	S	S	S	S	S	H
BARCSOYSSR_18_1626	56,966,941	S	S	H	H	H	H	H	S	H	H	S	S	S	S	S	S	S	H
BARCSOYSSR_18_1631	57,040,422	S	S	S	H	H	H	H	S	H	H	S	S	S	S	S	S	S	H
BARCSOYSSR_18_1641	57,134,393	S	S	S	H	H	H	H	S	H	H	S	S	S	S	S	S	H	H
BARCSOYSSR_18_1645	57,182,271	S	S	S	H	H	H	H	S	H	H	S	S	S	S	S	S	H	H
BARCSOYSSR_18_1661	57,386,156	S	S	S	S	S	S	H	S	H	H	S	S	S	S	S	H	H	H
BARCSOYSSR_18_1664	57,428,776	S	S	S	S	S	S	H	S	H	H	S	S	S	S	S	H	H	H
BARCSOYSSR_18_1665	57,436,776	S	S	S	S	S	S	H	S	H	H	S	S	S	S	H	H	H	H
BARCSOYSSR_18_1669	57,490,745	S	S	S	S	S	S	H	S	H	H	S	S	S	H	H	H	H	H
BARCSOYSSR_18_1670	57,505,749	S	S	S	S	S	S	H	S	H	H	S	S	S	H	H	H	H	H
BARCSOYSSR_18_1674	57,605,344	S	S	S	S	S	S	H	S	H	H	S	S	S	H	H	H	H	H
BARCSOYSSR_18_1675	57,637,254	S	S	S	S	S	S	S	H	H	H	S	S	S	H	H	H	H	H
BARCSOYSSR_18_1676	57,682,667	S	S	S	S	S	S	S	H	H	H	S	H	H	H	H	H	H	H
BARCSOYSSR_18_1677	57,689,794	S	S	S	S	S	S	S	H	H	H	S	H	H	H	H	H	H	H
BARCSOYSSR_18_1678	57,742,177	S	S	S	S	S	S	S	H	H	H	S	H	H	H	H	H	H	H
BARCSOYSSR_18_1690	57,979,439	S	S	S	S	S	S	S	H	S	H	S	H	H	H	H	H	H	H
BARCSOYSSR_18_1704	58,095,287	S	S	S	S	S	S	S	H	S	H	H	H	H	H	H	H	H	H
Satt472	58,136,286	S	S	S	S	S	S	S	H	S	S	H	H	H	H	H	H	H	H

Chromosome 18 QTL

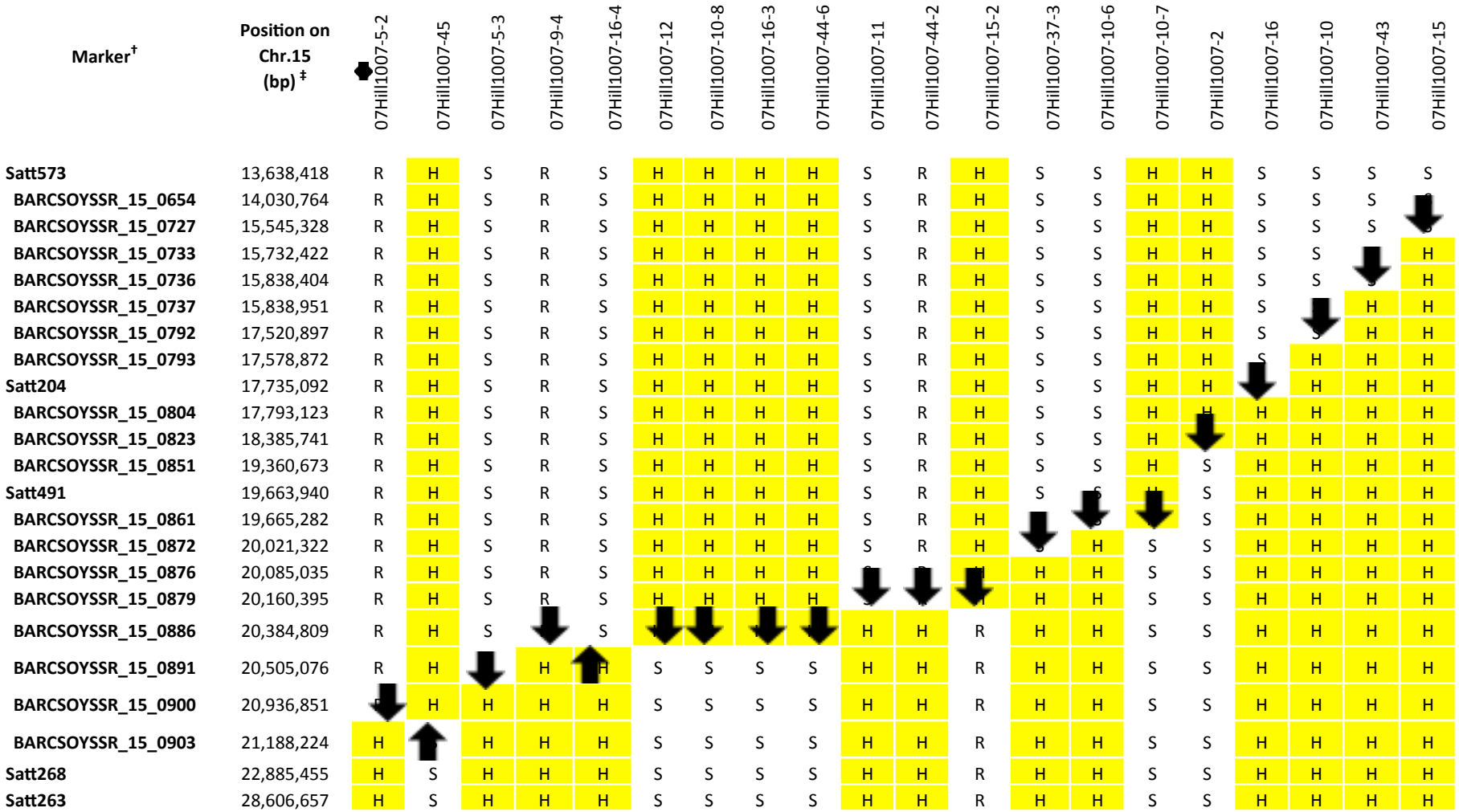
Marker†	Position on Chr. 18 (bp)‡	07Hill-986-5	07Hill-986-6	07Hill-986-1	07Hill-986-8	07Hill-986-72	07Hill-986-86	07Hill-984-5	07Hill-986-19	07Hill-986-73	07Hill-986-14	07Hill-986-20	07Hill-986-57	07Hill-984-2	07Hill-986-35	07Hill-986-46	07Hill-986-75	07Hill-986-76	07Hill-986-38
Satt288	55,407,119	S§	S	S	S	S	S	H	S	S	S	S	S	S	S	S	S	S	S
BARCSOYSSR_18_1551	55,658,334	S	S	S	S	S	S	H	S	S	S	S	S	S	S	S	S	S	S
BARCSOYSSR_18_1570	56,037,903	H	H	H	H	H	H	H	S	H	H	S	S	S	S	S	S	S	S
BARCSOYSSR_18_1588	56,364,465	H	H	H	H	H	H	H	S	H	H	S	S	S	S	S	S	S	S
BARCSOYSSR_18_1593	56,423,682	H	H	H	H	H	H	H	S	H	H	S	S	S	S	S	S	S	H
BARCSOYSSR_18_1600	56,482,347	H	H	H	H	H	H	H	S	H	H	S	S	S	S	S	S	S	H
BARCSOYSSR_18_1603	56,568,347	S	H	H	H	H	H	H	S	H	H	S	S	S	S	S	S	S	H
BARCSOYSSR_18_1605	56,569,542	S	S	H	H	H	H	H	S	H	H	S	S	S	S	S	S	S	H
BARCSOYSSR_18_1614	56,696,421	S	S	H	H	H	H	H	S	H	H	S	S	S	S	S	S	S	H
BARCSOYSSR_18_1626	56,966,941	S	S	H	H	H	H	H	S	H	H	S	S	S	S	S	S	S	H
BARCSOYSSR_18_1631	57,040,422	S	S	S	H	H	H	H	S	H	H	S	S	S	S	S	S	S	H
BARCSOYSSR_18_1641	57,134,393	S	S	S	H	H	H	H	S	H	H	S	S	S	S	S	S	S	H
BARCSOYSSR_18_1645	57,182,271	S	S	S	H	H	H	H	S	H	H	S	S	S	S	S	S	H	H
BARCSOYSSR_18_1661	57,386,156	S	S	S	S	S	S	H	S	H	H	S	S	S	S	S	H	H	H
BARCSOYSSR_18_1664	57,428,776	S	S	S	S	S	S	H	S	H	H	S	S	S	S	S	H	H	H
BARCSOYSSR_18_1665	57,436,776	S	S	S	S	S	S	H	S	H	H	S	S	S	S	H	H	H	H
BARCSOYSSR_18_1669	57,490,745	S	S	S	S	S	S	H	S	H	H	S	S	S	H	H	H	H	H
BARCSOYSSR_18_1670	57,505,749	S	S	S	S	S	S	H	S	H	H	S	S	S	H	H	H	H	H
BARCSOYSSR_18_1674	57,605,344	S	S	S	S	S	S	H	S	H	H	S	S	S	H	H	H	H	H
BARCSOYSSR_18_1675	57,637,254	S	S	S	S	S	S	H	H	H	H	S	S	S	H	H	H	H	H
BARCSOYSSR_18_1676	57,682,667	S	S	S	S	S	S	S	H	H	H	S	H	H	H	H	H	H	H
BARCSOYSSR_18_1677	57,689,794	S	S	S	S	S	S	S	H	H	H	S	H	H	H	H	H	H	H
BARCSOYSSR_18_1678	57,742,177	S	S	S	S	S	S	S	H	H	H	S	H	H	H	H	H	H	H
BARCSOYSSR_18_1690	57,979,439	S	S	S	S	S	S	S	H	S	H	S	H	H	H	H	H	H	H
BARCSOYSSR_18_1704	58,095,287	S	S	S	S	S	S	S	H	S	H	H	H	H	H	H	H	H	H
Satt472	58,136,286	S	S	S	S	S	S	S	H	S	S	H	H	H	H	H	H	H	H

146.5 kb interval

Chromosome 15 QTL

Marker†	Position on Chr.15 (bp) ‡	07Hill1007-5-2	07Hill1007-45	07Hill1007-5-3	07Hill1007-9-4	07Hill1007-16-4	07Hill1007-12	07Hill1007-10-8	07Hill1007-16-3	07Hill1007-44-6	07Hill1007-11	07Hill1007-44-2	07Hill1007-15-2	07Hill1007-37-3	07Hill1007-10-6	07Hill1007-10-7	07Hill1007-2	07Hill1007-16	07Hill1007-10	07Hill1007-43	07Hill1007-15
Satt573	13,638,418	R	H	S	R	S	H	H	H	H	S	R	H	S	S	H	H	S	S	S	S
BARCSOYSSR_15_0654	14,030,764	R	H	S	R	S	H	H	H	H	S	R	H	S	S	H	H	S	S	S	S
BARCSOYSSR_15_0727	15,545,328	R	H	S	R	S	H	H	H	H	S	R	H	S	S	H	H	S	S	S	S
BARCSOYSSR_15_0733	15,732,422	R	H	S	R	S	H	H	H	H	S	R	H	S	S	H	H	S	S	S	H
BARCSOYSSR_15_0736	15,838,404	R	H	S	R	S	H	H	H	H	S	R	H	S	S	H	H	S	S	S	H
BARCSOYSSR_15_0737	15,838,951	R	H	S	R	S	H	H	H	H	S	R	H	S	S	H	H	S	S	H	H
BARCSOYSSR_15_0792	17,520,897	R	H	S	R	S	H	H	H	H	S	R	H	S	S	H	H	S	S	H	H
BARCSOYSSR_15_0793	17,578,872	R	H	S	R	S	H	H	H	H	S	R	H	S	S	H	H	S	H	H	H
Satt204	17,735,092	R	H	S	R	S	H	H	H	H	S	R	H	S	S	H	H	S	H	H	H
BARCSOYSSR_15_0804	17,793,123	R	H	S	R	S	H	H	H	H	S	R	H	S	S	H	H	H	H	H	H
BARCSOYSSR_15_0823	18,385,741	R	H	S	R	S	H	H	H	H	S	R	H	S	S	H	H	H	H	H	H
BARCSOYSSR_15_0851	19,360,673	R	H	S	R	S	H	H	H	H	S	R	H	S	S	H	S	H	H	H	H
Satt491	19,663,940	R	H	S	R	S	H	H	H	H	S	R	H	S	S	H	S	H	H	H	H
BARCSOYSSR_15_0861	19,665,282	R	H	S	R	S	H	H	H	H	S	R	H	S	S	H	S	H	H	H	H
BARCSOYSSR_15_0872	20,021,322	R	H	S	R	S	H	H	H	H	S	R	H	S	H	S	S	H	H	H	H
BARCSOYSSR_15_0876	20,085,035	R	H	S	R	S	H	H	H	H	S	R	H	H	H	S	S	H	H	H	H
BARCSOYSSR_15_0879	20,160,395	R	H	S	R	S	H	H	H	H	S	R	H	H	H	S	S	H	H	H	H
BARCSOYSSR_15_0886	20,384,809	R	H	S	R	S	H	H	H	H	H	H	R	H	H	S	S	H	H	H	H
BARCSOYSSR_15_0891	20,505,076	R	H	S	H	H	S	S	S	S	H	H	R	H	H	S	S	H	H	H	H
BARCSOYSSR_15_0900	20,936,851	R	H	H	H	H	S	S	S	S	H	H	R	H	H	S	S	H	H	H	H
BARCSOYSSR_15_0903	21,188,224	H	S	H	H	H	S	S	S	S	H	H	R	H	H	S	S	H	H	H	H
Satt268	22,885,455	H	S	H	H	H	S	S	S	S	H	H	R	H	H	S	S	H	H	H	H
Satt263	28,606,657	H	S	H	H	H	S	S	S	S	H	H	R	H	H	S	S	H	H	H	H

Chromosome 15 QTL



Chromosome 15 QTL

Marker†	Position on Chr.15 (bp) ‡	07Hill1007-5-2	07Hill1007-45	07Hill1007-5-3	07Hill1007-9-4	07Hill1007-16-4	07Hill1007-12	07Hill1007-10-8	07Hill1007-16-3	07Hill1007-44-6	07Hill1007-11	07Hill1007-44-2	07Hill1007-15-2	07Hill1007-37-3	07Hill1007-10-6	07Hill1007-10-7	07Hill1007-2	07Hill1007-16	07Hill1007-10	07Hill1007-43	07Hill1007-15
Satt573	13,638,418	R	H	S	R	S	H	H	H	H	S	R	H	S	S	H	H	S	S	S	S
BARCSOYSSR_15_0654	14,030,764	R	H	S	R	S	H	H	H	H	S	R	H	S	S	H	H	S	S	S	
BARCSOYSSR_15_0727	15,545,328	R	H	S	R	S	H	H	H	H	S	R	H	S	S	H	H	S	S	S	
BARCSOYSSR_15_0733	15,732,422	R	H	S	R	S	H	H	H	H	S	R	H	S	S	H	H	S	S		H
BARCSOYSSR_15_0736	15,838,404	R	H	S	R	S	H	H	H	H	S	R	H	S	S	H	H	S	S		H
BARCSOYSSR_15_0737	15,838,951	R	H	S	R	S	H	H	H	H	S	R	H	S	S	H	H	S		H	H
BARCSOYSSR_15_0792	17,520,897	R	H	S	R	S	H	H	H	H	S	R	H	S	S	H	H	S		H	H
BARCSOYSSR_15_0793	17,578,872	R	H	S	R	S	H	H	H	H	S	R	H	S	S	H	H	S	H	H	H
Satt204	17,735,092	R	H	S	R	S	H	H	H	H	S	R	H	S	S	H	H		H	H	H
BARCSOYSSR_15_0804	17,793,123	R	H	S	R	S	H	H	H	H	S	R	H	S	S	H		H	H	H	H
BARCSOYSSR_15_0823	18,385,741	R	H	S	R	S	H	H	H	H	S	R	H	S	S	H		H	H	H	H
BARCSOYSSR_15_0851	19,360,673	R	H	S	R	S	H	H	H	H	S	R	H	S	S	H	S	H	H	H	H
Satt491	19,663,940	R	H	S	R	S	H	H	H	H	S	R	H	S			S	H	H	H	H
BARCSOYSSR_15_0861	19,665,282	R	H	S	R	S	H	H	H	H	S	R	H				S	H	H	H	H
BARCSOYSSR_15_0872	20,021,322	R	H	S	R	S	H	H	H	H	S	R	H		H	S	S	H	H	H	H
BARCSOYSSR_15_0876	20,085,035	R	H	S	R	S	H	H	H	H				H	H	S	S	H	H	H	H
BARCSOYSSR_15_0879	20,160,395	R	H	S	R	S	H	H	H	H				H	H	S	S	H	H	H	H
BARCSOYSSR_15_0886	20,384,809	R	H	S		S					H	H	R	H	H	S	S	H	H	H	H
BARCSOYSSR_15_0891	20,505,076	R	H		H	H	S	S	S	S	H	H	R	H	H	S	S	H	H	H	H
BARCSOYSSR_15_0900	20,936,851		H	H	H	H	S	S	S	S	H	H	R	H	H	S	S	H	H	H	H
BARCSOYSSR_15_0903	21,188,224	H		H	H	H	S	S	S	S	H	H	R	H	H	S	S	H	H	H	H
Satt268	22,885,455	H	S	H	H	H	S	S	S	S	H	H	R	H	H	S	S	H	H	H	H
Satt263	28,606,657	H	S	H	H	H	S	S	S	S	H	H	R	H	H	S	S	H	H	H	H

804.4 kb (likely 251 kb) interval

Conclusion

- PI 88788 overused resistance source.
  - This resistance still generally working well.
- Yield advantage for SCN resistance can be shown.
- Difficult to show general yield advantage of PI 437654 resistance.
- Two SCN resistance QTL from *G. soja* can improve resistance from PI 88788.
- *G. soja* QTL were fine mapped.

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Andrew Scaboo – University of Missouri
William Schapaugh – Kansas State
Grover Shannon – University of Missouri
Claire Venard – University of Kentucky
Dechun Wang – Michigan State
Tom Welacky - GPCRC

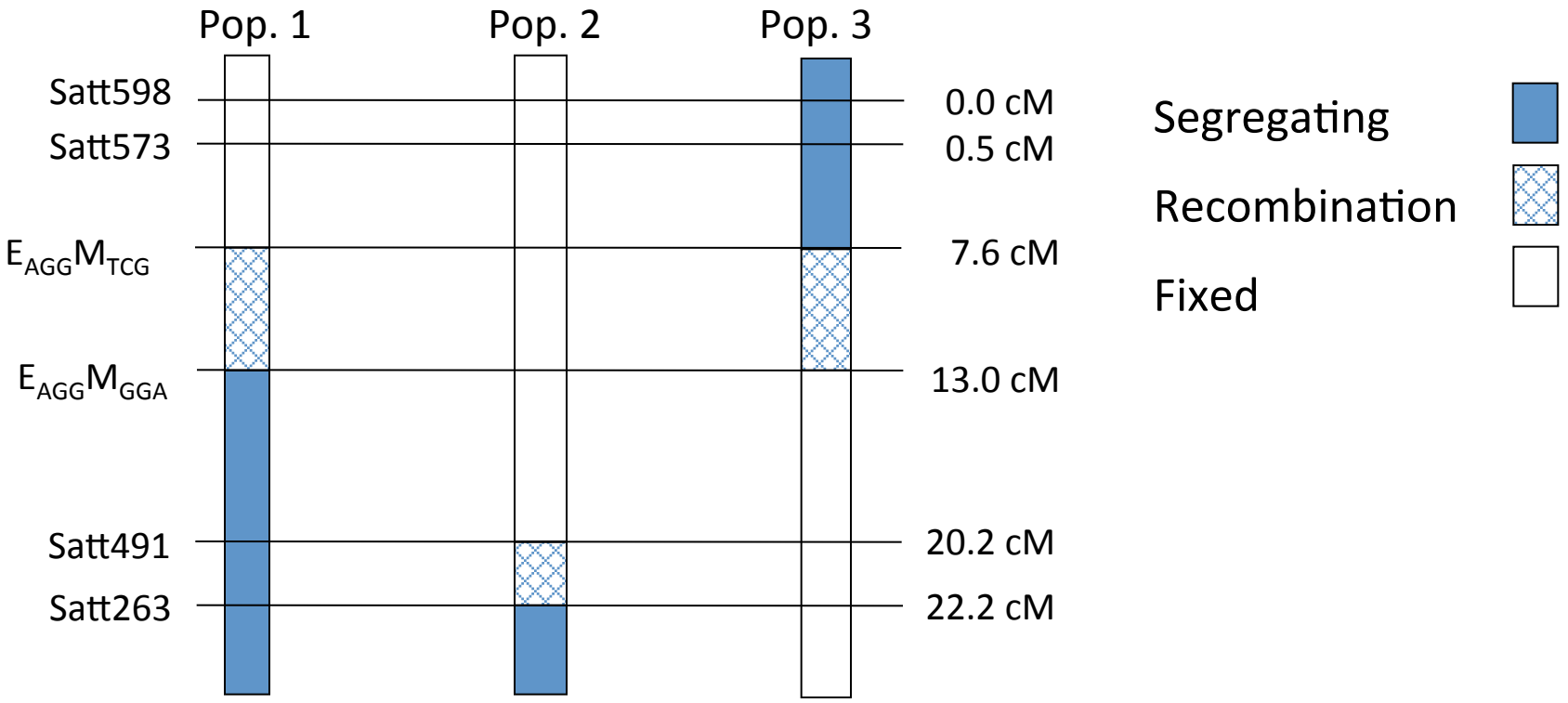
Yield Test of a BC4 Population Segregating for *G. soja* Resistance

	Yield			
Linkage Group	P>F	*G. soja*	*G. max*	Other significance
E	0.006	46.6	45.4	Later mat. (0.75 days)
G	0.004	46.8	45.4	Greater lod. (0.15 units)

Research Themes

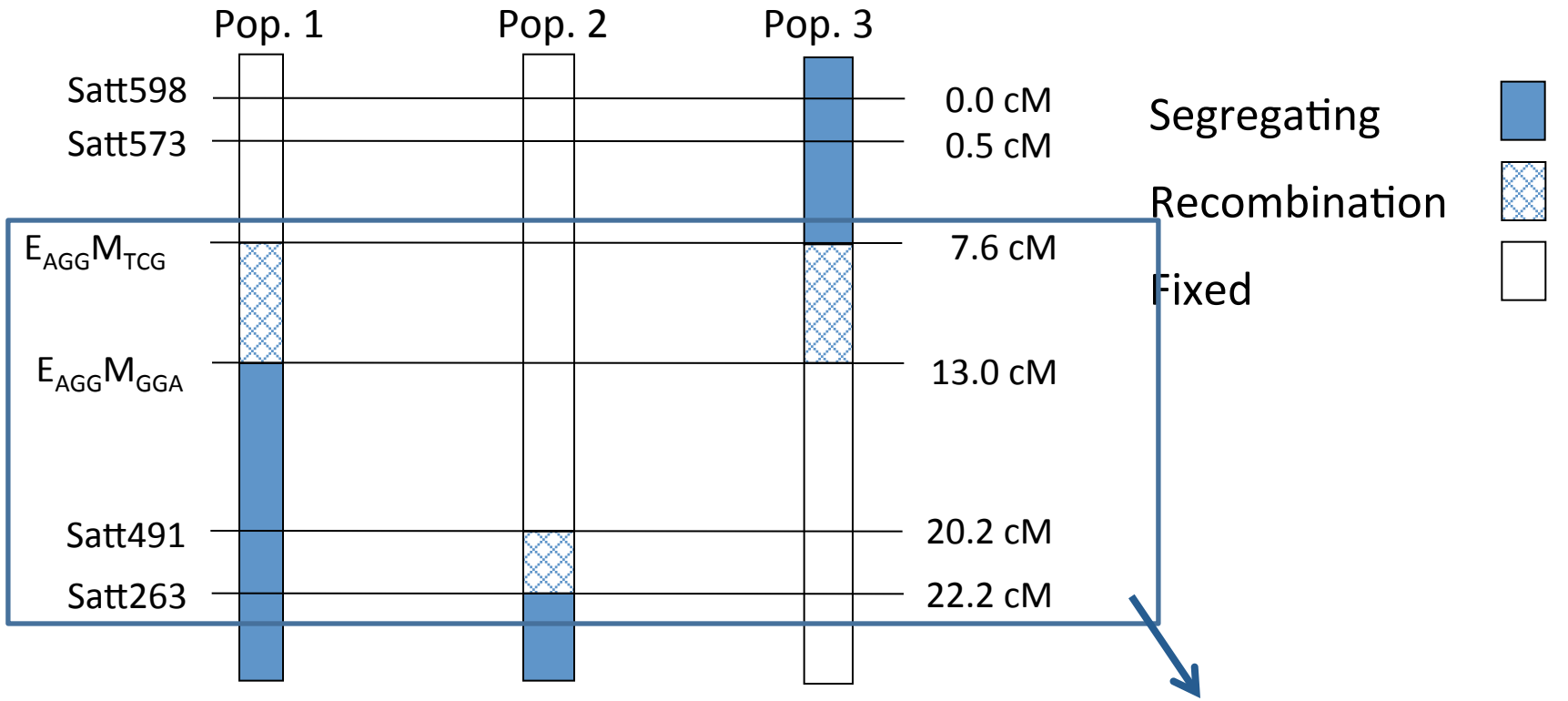
- Understand the importance of SCN resistance.
- Study SCN resistance genes
- Breed for SCN resistance with an emphasis on new resistance sources.

Fine Mapping *G. soja* QTL Chromosome 15



	FI	FI	FI
G. soja	21	85	68
A81-356022	68	92	66
P-value	0.0001	0.36	0.77

Fine Mapping *G. soja* QTL Chromosome 15



	FI	FI	FI
G. soja	21	85	68
A81-356022	68	92	66
P-value	0.0001	0.36	0.77

Effects of Resistance Gene Combinations (Prakash Arelli)

	SCN Isolate				
	LY1	R1 (PA1)	R2 (PA2)	R3 (PA3)	R5 (PA5)
2 *G. soja*	71	16	54	27	40
PI437654 (LD00-2817)	72	1	14	1	4
2 *G. soja* + 437654	39	0	7	0	1

Effects of Resistance Gene Combinations (Prakash Arelli)

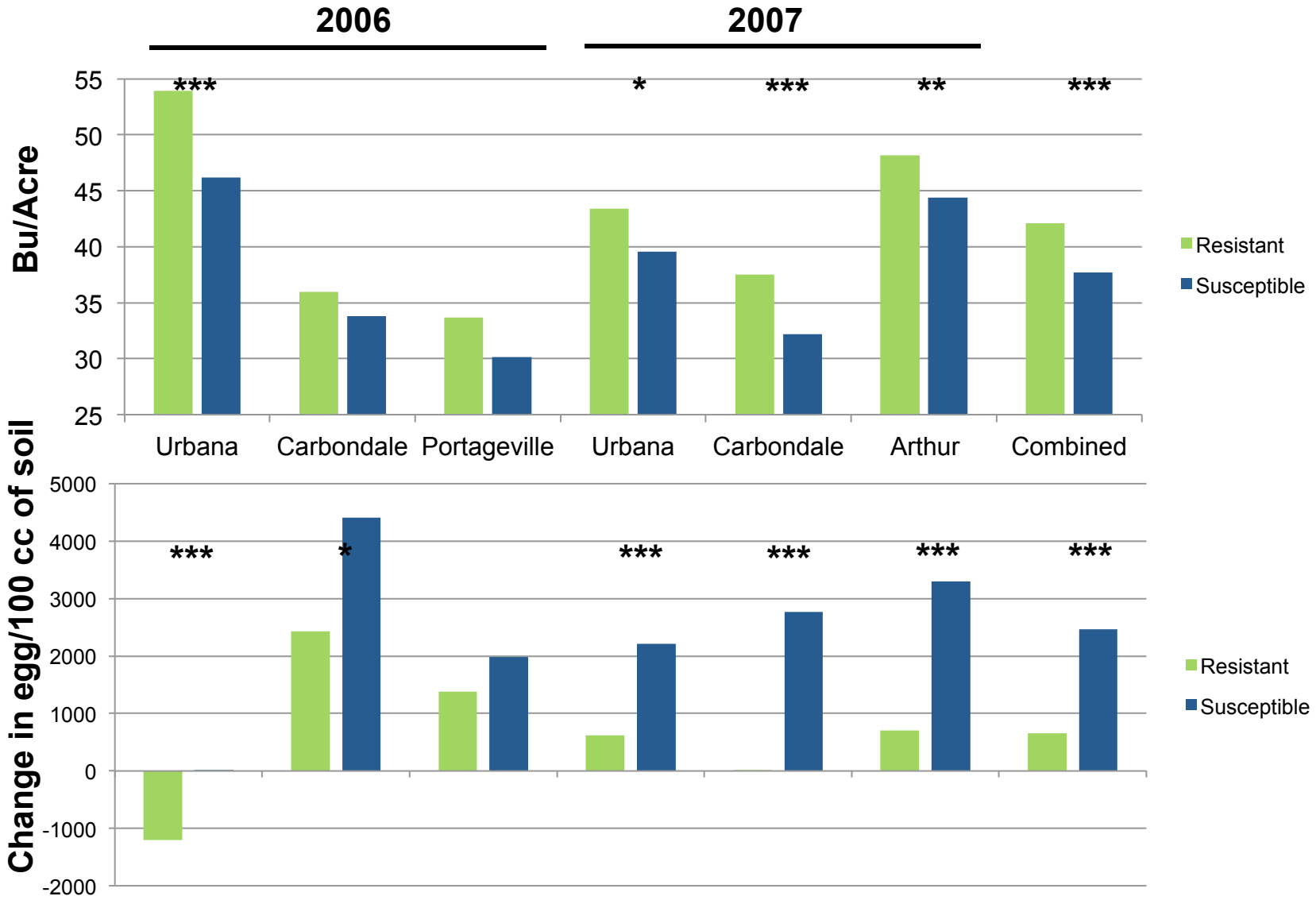
	SCN Isolate				
	LY1	R1 (PA1)	R2 (PA2)	R3 (PA3)	R5 (PA5)
2 *G. soja*	71	16	54	27	40
PI437654 (LD00-2817)	72	1	14	1	4
2 *G. soja* + 437654	39	0	7	0	1

Impact of SCN Resistance on Yield

Jake Delheimer

- Can we detect the effects of resistance alleles in field environments?
- Tested NILs segregating for *rhg1*.
  - Yield
  - SCN reproduction

Effect of *rhg1* from PI 88788



Effects of *rhg1* from PI 88788 and PI 437654