

EVALUATION AND IDENTIFICATION OF SOYBEAN APHID RESISTANCE SOURCES AND MAPPING OF SOYBEAN APHID RESISTANCE LOCI IN EARLY MATURING SOYBEAN GERMPLASM ACCESSION

Results of my Graduate researches at South Dakota State University

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D Wright, and J Gonzalez**

Soybean Breeders Workshop

Feb 13-15, 2017

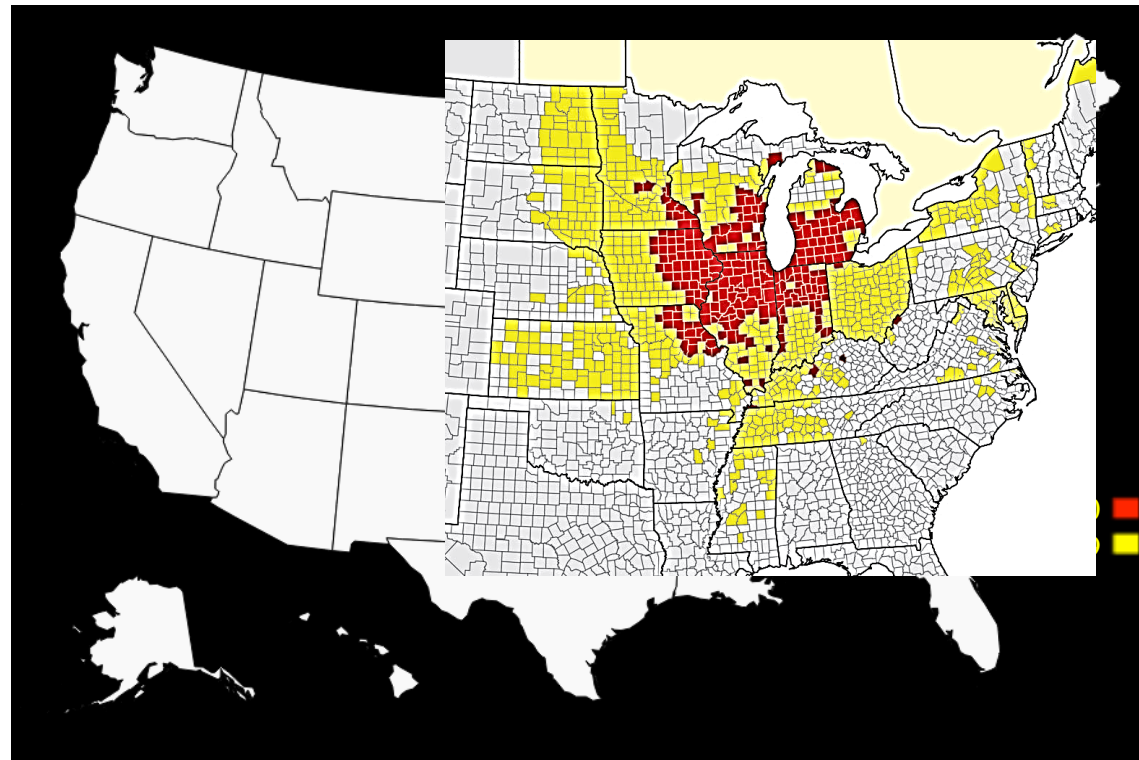
Soybean aphid in the United States

One of the major pests of Soybean

First reported in 2000

Spread up to 80% of soybean cultivation area in 2002

Detected in 30 states by 2009

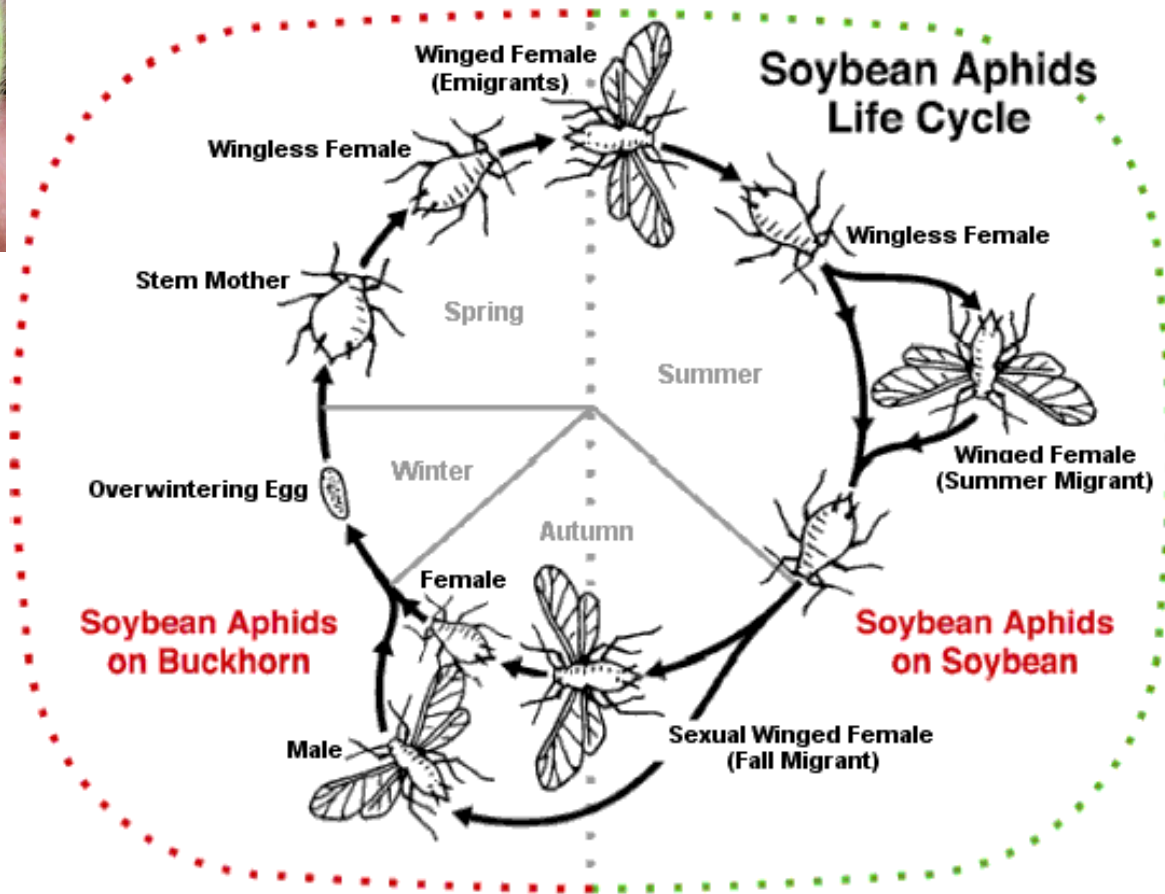


Soybean aphid, *Aphis glycines* Matsumara



- Suck the plant sap
- Transmit viral diseases
- Sooty mold development
- Yield loss of 40% or more on severe infestation

Soybean aphid, *Aphis glycines* Matsumara

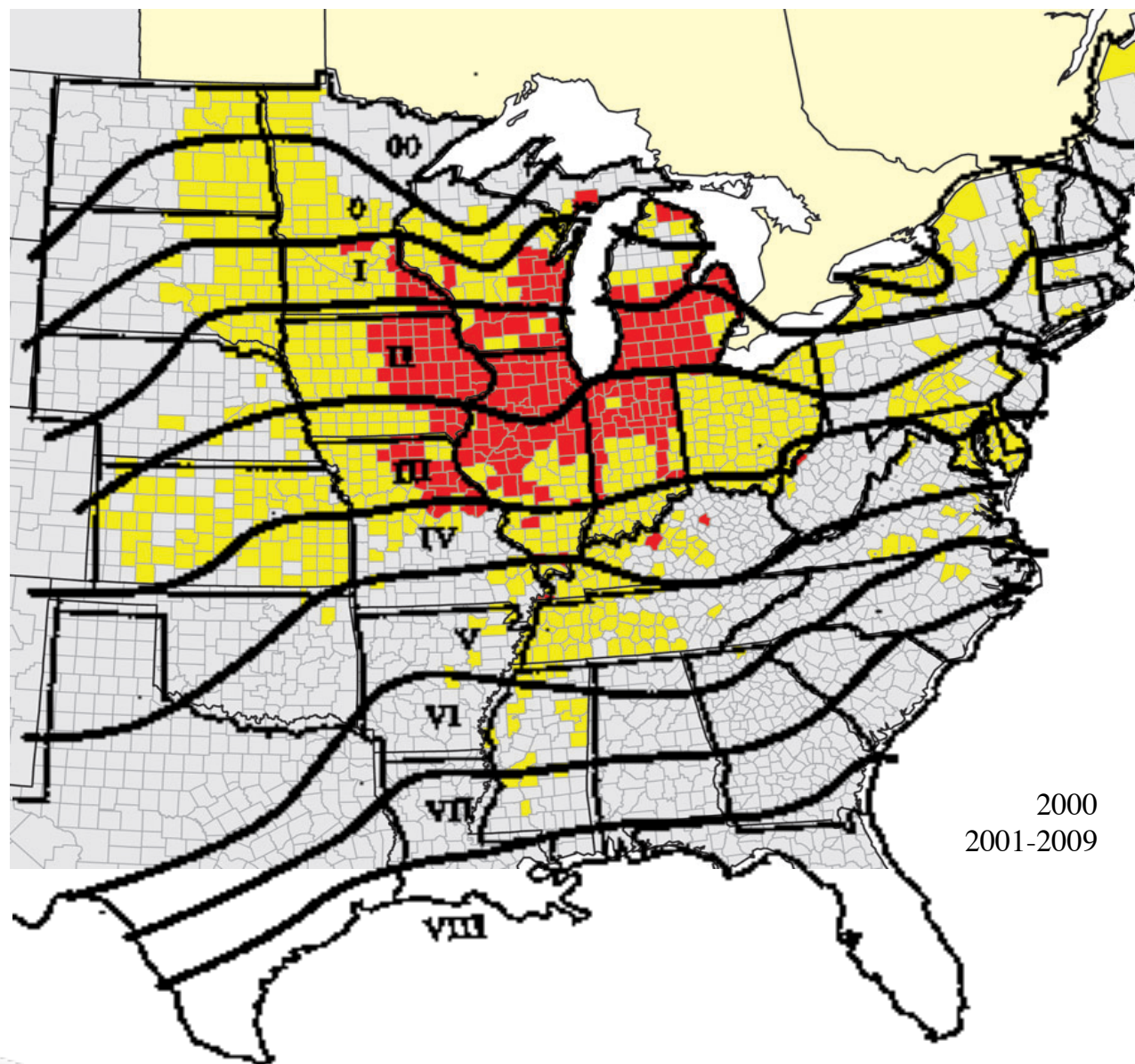


➤ **Life cycle: heteroecious holocyclic**
(*host-alternating with sexual reproduction during part of its life cycle*).

Soybean aphid resistance sources

Resistant loci	Source	Maturity Group	Remarks
<i>Rag1</i>	PI 548663 (Dowling)	VIII	Hill et al., 2006
<i>Rag2</i>	PI 243540 and PI 200538	IV VIII	Mian et al., 2008; Hill et al., 2009
<i>Rag3</i>	PI 567543C	III	Zhang et al., 2010
<i>rag4</i> and <i>rag1c</i>	PI 567541B	III	Zhang et al., 2009
<i>rag1b</i> and <i>rag3</i>	PI 567598B	III	Bales et al., 2013
<i>Rag6</i>	P203 from China	VIII	Xiao et al., 2013
....	...		Keeps coming....

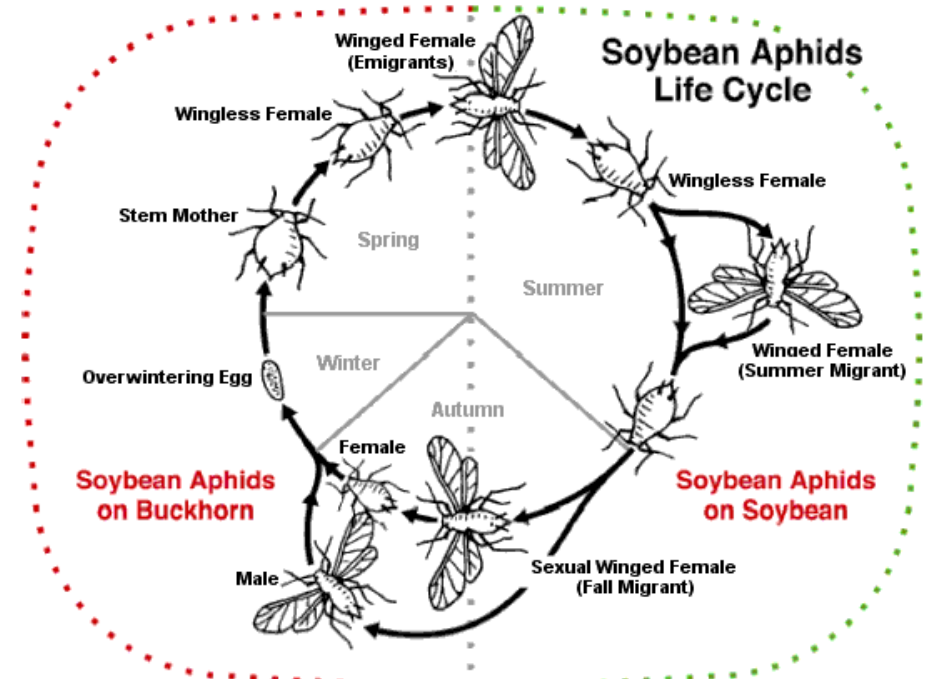
Soybean aphid distribution vs Maturity Group Map



Hartman et al., 2001; Venette and Ragsdale, 2004; Ragsdale et al., 2011

Soybean aphid biotypes

- **Biotype 1: Avirulent to known resistance sources**
- **Biotype 2: Virulent to *Rag1***
- **Biotype 3: Virulent to *Rag2***
- **Biotype 4: Virulent to both *Rag1* and *Rag2***
-
- **Keeps coming.....**



Objectives

- **Identify soybean aphid resistance sources in early maturing soybean germplasm accessions**
- **Map and characterize soybean aphid resistance and identify associated markers to be used in soybean breeding programs**

Evaluation of Soybean aphid resistance in Early Maturing soybeans

1.a. Maturity Group (MG) 00 and

0334 soybean germplasm accessions

326 accessions from MG '0' and '00'

6 resistant checks

2 susceptible checks

1.b. Maturity Group

(MG) I

341 soybean germplasm accessions

330 accessions from MG I

8 resistant checks

3 susceptible checks

RESEARCH

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Identification of Soybean Aphid Resistance in Early Maturing Genotypes of Soybean

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ABSTRACT

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RESEARCH

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Soybean Aphid Resistance in Soybean Germplasm Accessions of Maturity Group I

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ABSTRACT

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Results: Maturity group 00 and 0

Category	Greenhouse tests	
	Caged	Non-caged
R	4 <i><60 aphids plant-1</i>	4 <i>score 1.0-1.9</i>
MR	8 <i>60-130 aphids plant-1</i>	8 <i>score 2.0-2.9</i>

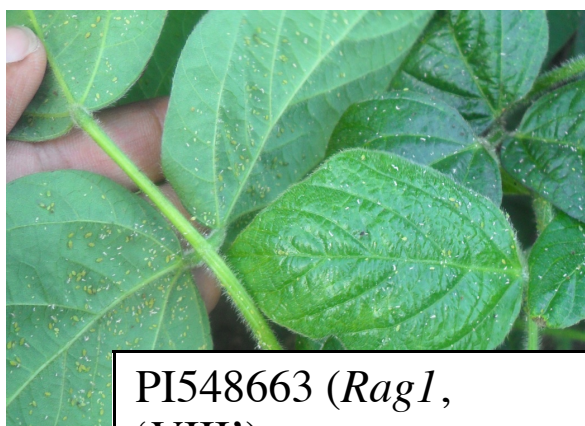
R, resistant; MR, moderately resistant

Results: Maturity group 00 and 0

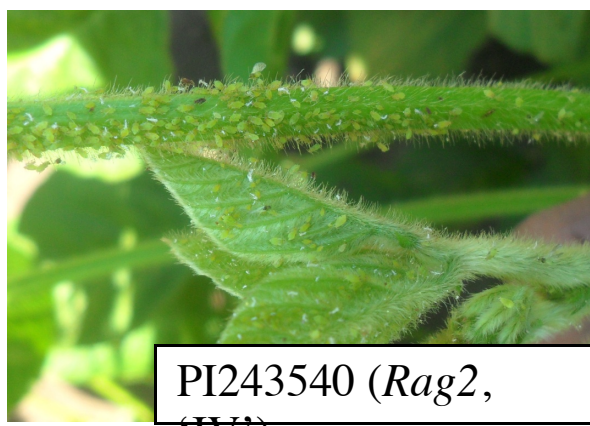
Category	Greenhouse tests		Field tests	
	Caged	Non-caged		
R	<p>4</p> <p><i><60 aphids plant-1</i></p>	<p>4</p> <p><i>score 1.0-1.9</i></p>	<p>1</p> <p><i>score 1.0-2.9</i></p>	PI 603712
MR	<p>8</p> <p><i>60-130 aphids plant-1</i></p>	<p>8</p> <p><i>score 2.0-2.9</i></p>	<p>1</p> <p><i>score 3.0-3.9</i></p>	PI 430491

R, resistant; MR, moderately resistant

Field screening (Aurora, SD), 2011



PI548663 (*Rag1*,
'VIII')



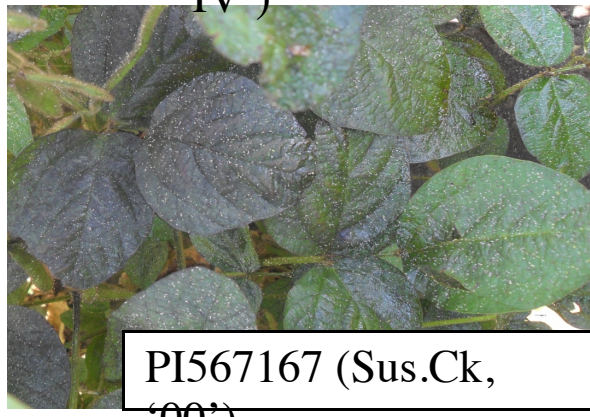
PI243540 (*Rag2*,
'IV')



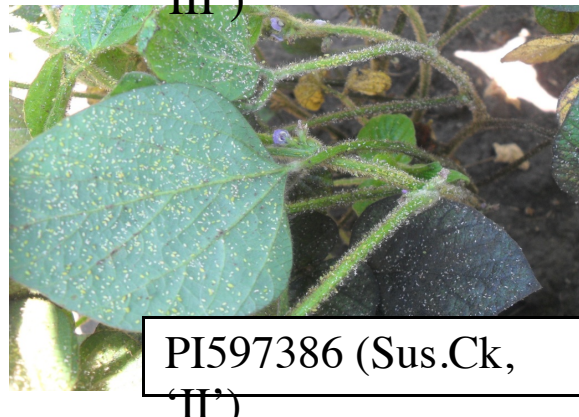
PI567543C (*Rag3*,
'III')



PI567541B (*rag4*,
'III')



PI567167 (*Sus.Ck*,
'00')



PI597386 (*Sus.Ck*,
'II')



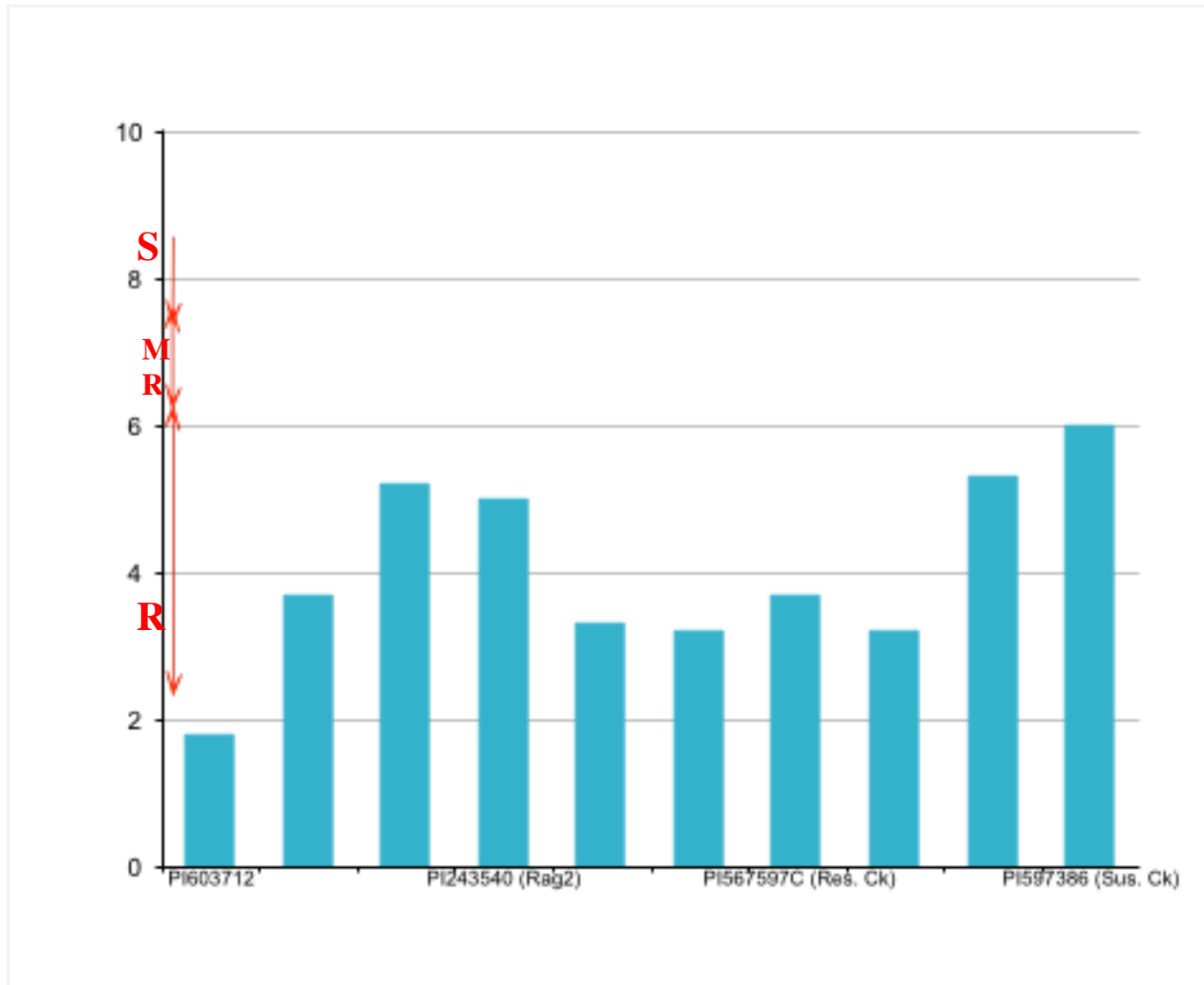
PI430491 (*New*,
'00')



PI603712 (*New*,
'0')

Soybean aphid infestation in different soybean genotypes (with resistance source and maturity group) in Aurora, 2011.

Results: Maturity group 00 and 0



Results: Maturity group I

Category	Greenhouse tests	
	Caged	Non-caged
R	8 <i><85 aphids plant-1</i>	3 <i>score 1.0-1.9</i>
MR	6 <i>85-135 aphids plant-1</i>	14 <i>score 2.0-2.9</i>

R, resistant; MR, moderately resistant

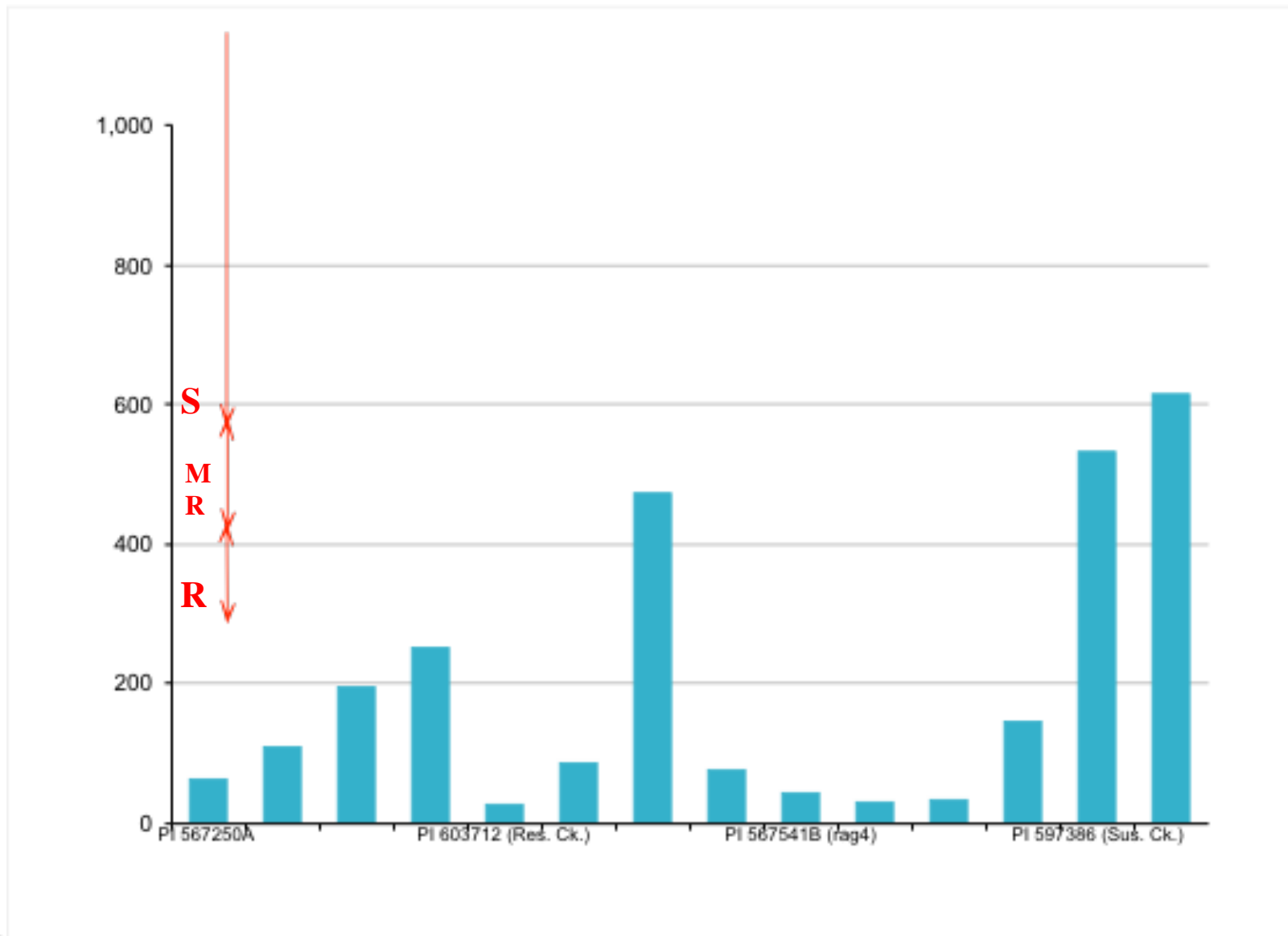


Results: Maturity group I

Category	Greenhouse tests		Field test	
	Caged	Non-caged		
R	8 <i><85 aphids plant-1</i>	3 <i>score 1.0-1.9</i>	2 <i><110 aphids plant-1</i>	PI 567250A PI 603339A
MR	6 <i>85-135 aphids plant-1</i>	14 <i>score 2.0-2.9</i>	2 <i>110-275 aphids plant-1</i>	PI 153214 PI 437075

R, resistant; MR, moderately resistant

Results: Maturity group I



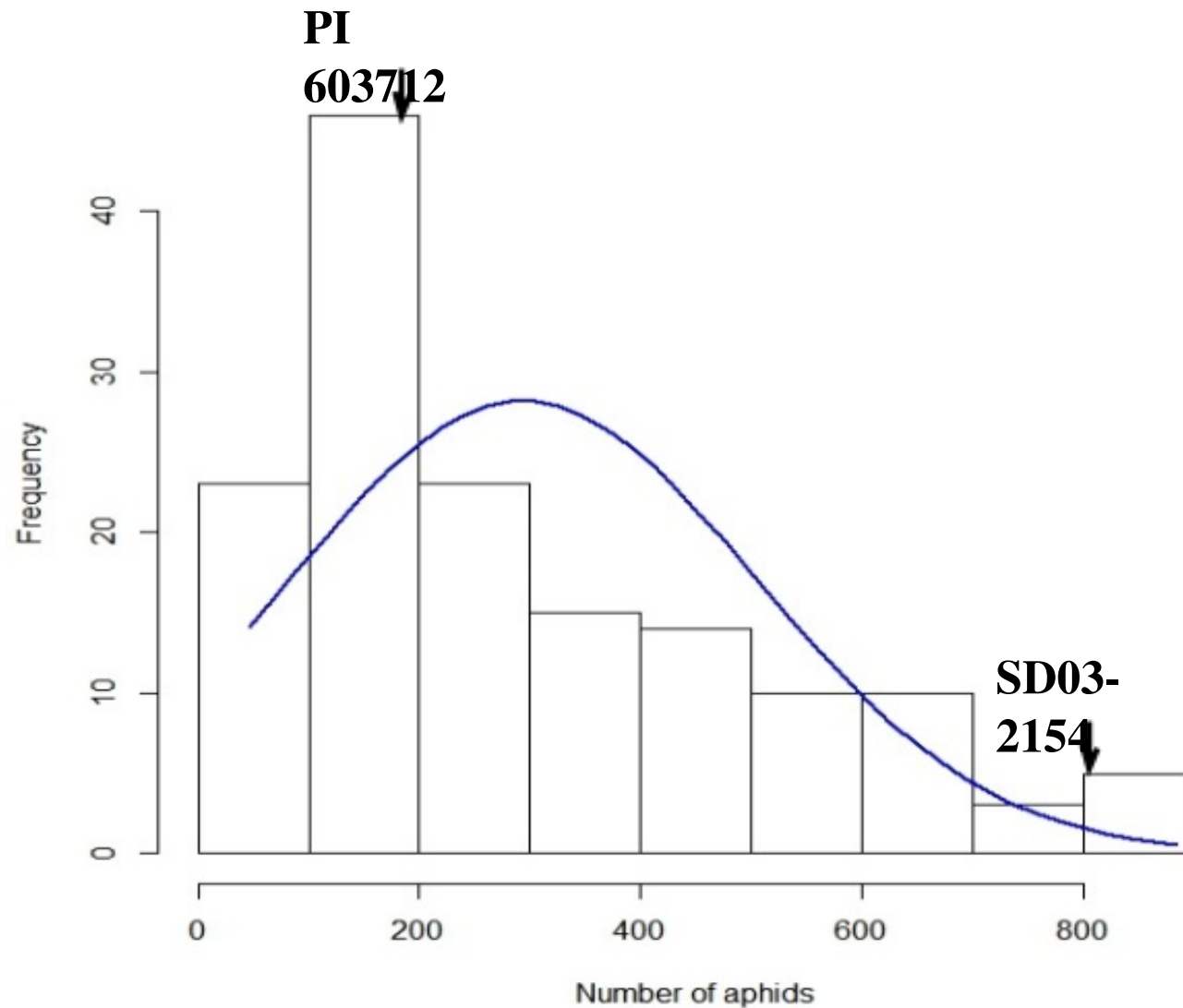
Linkage mapping of SA Resistance in PI 603712

- **SD03-2154 x PI 603712**
(‘Roberts’)
F1



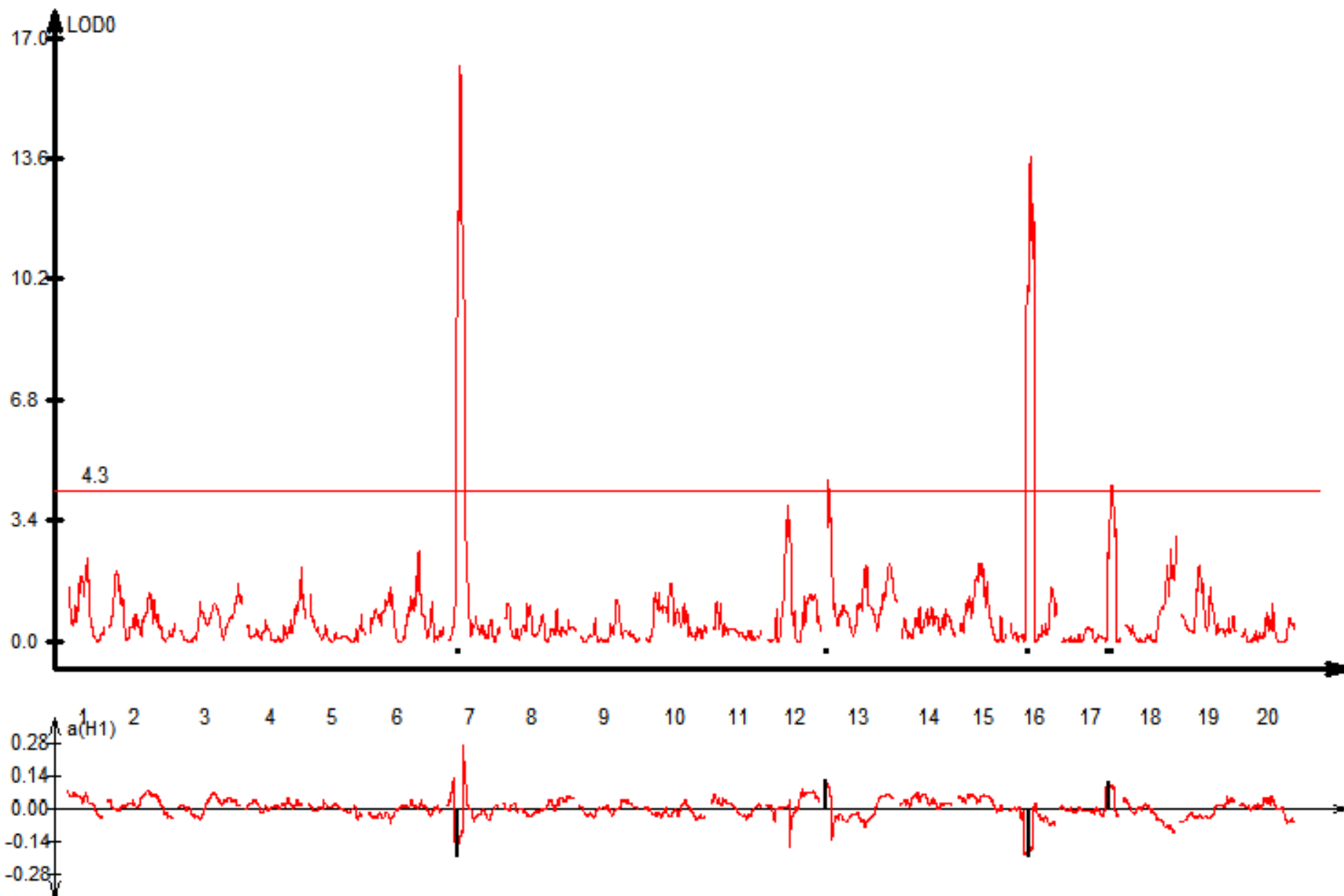
- **Phenotyping of 142 F2 plants in greenhouse**
- **Genotyping by BARCSoySNP6k Beadcheap**
- **Mapping**

Results: Phenotypic distribution

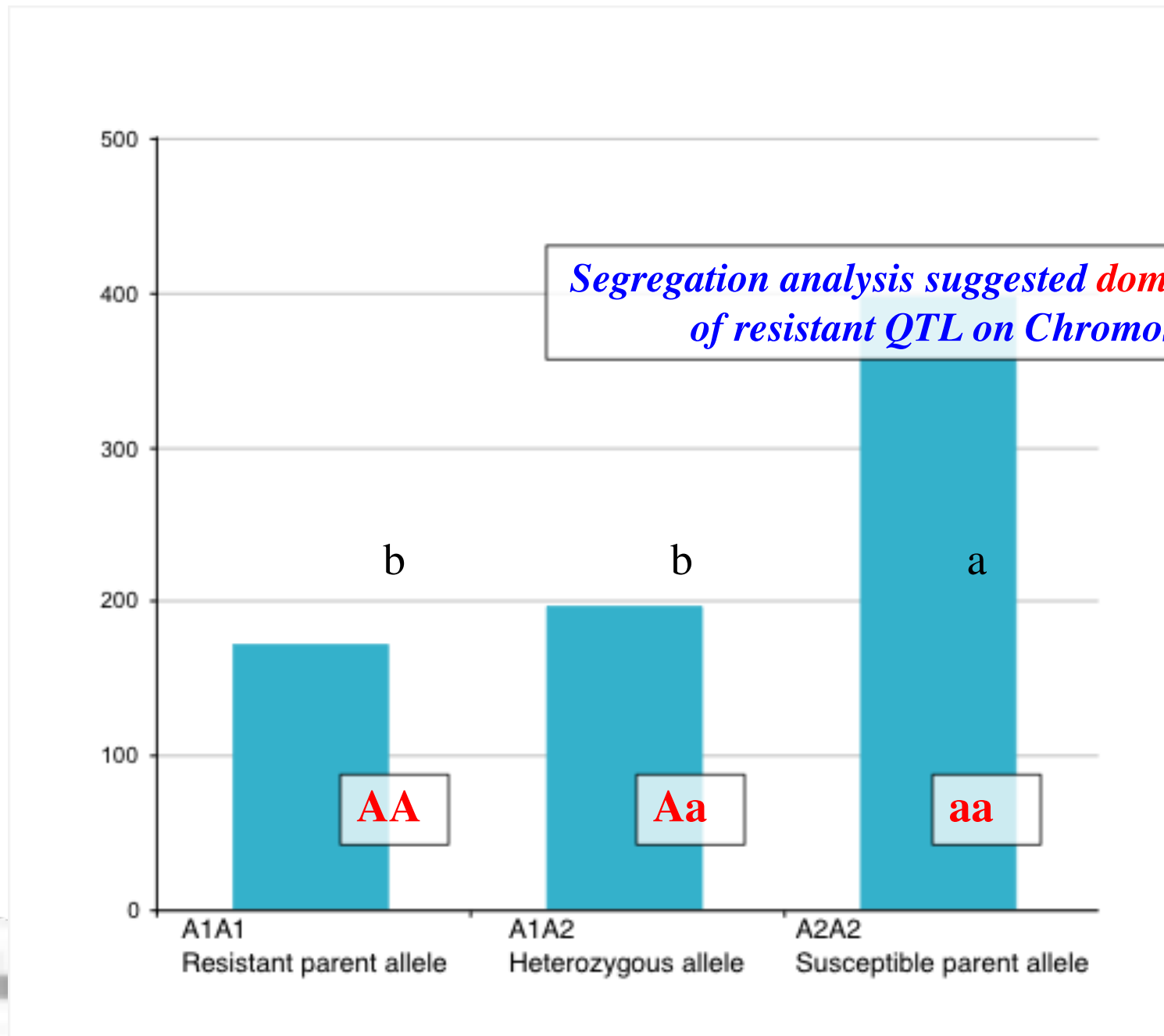


Histogram of soybean aphid resistance in F2 plants.

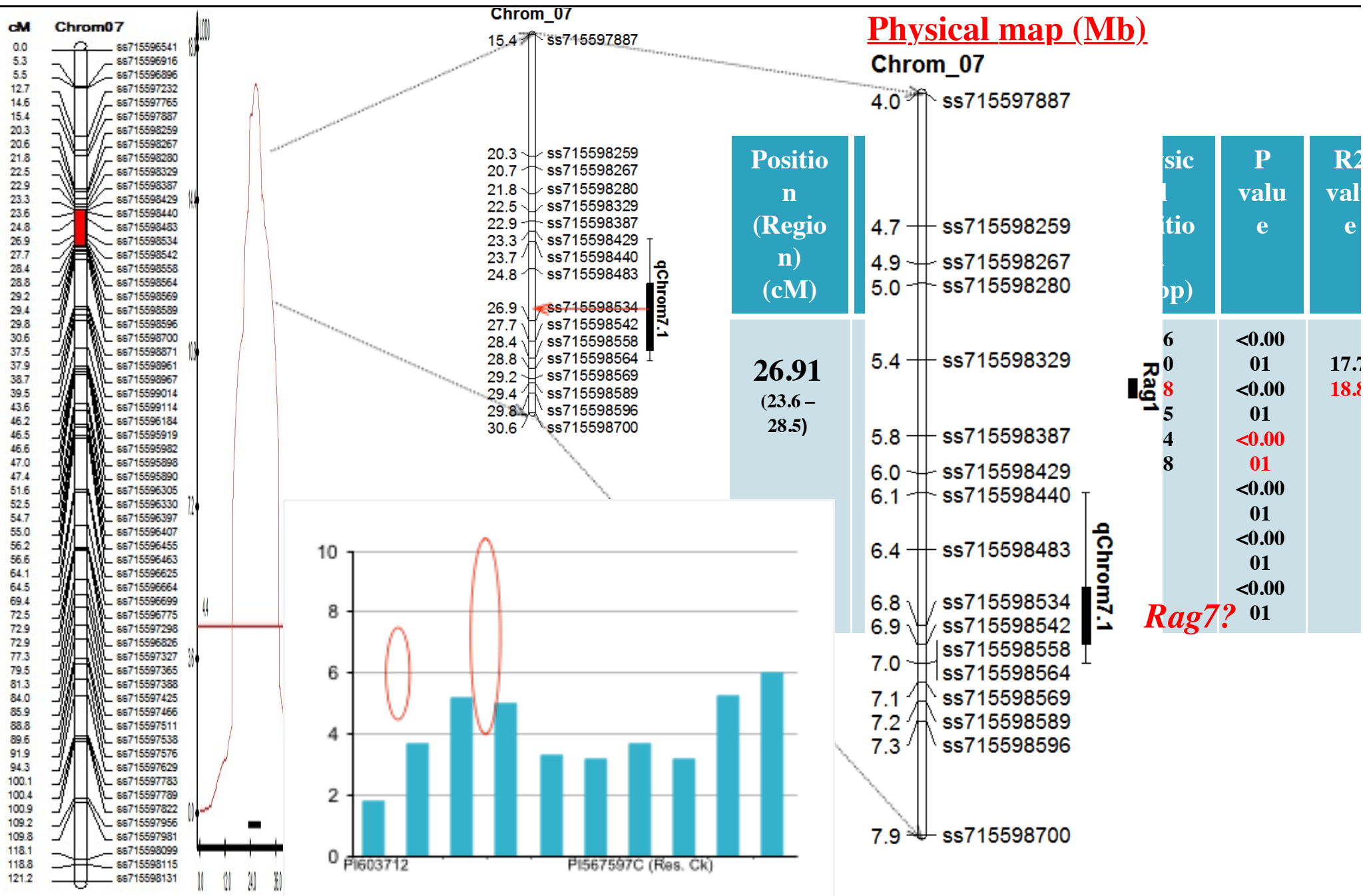
QTL Mapping



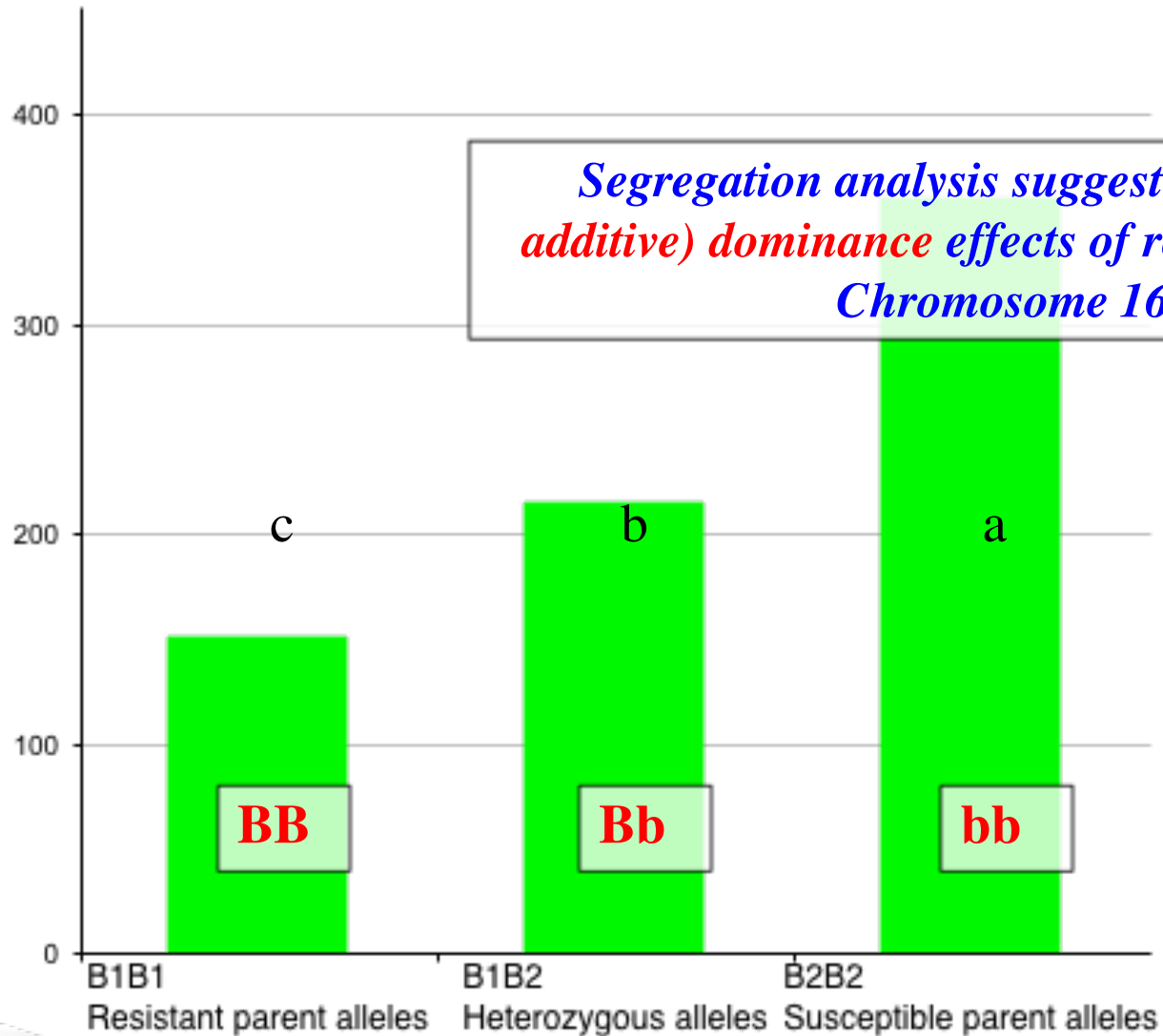
Segregation analysis: **Chromosome 7 locus**



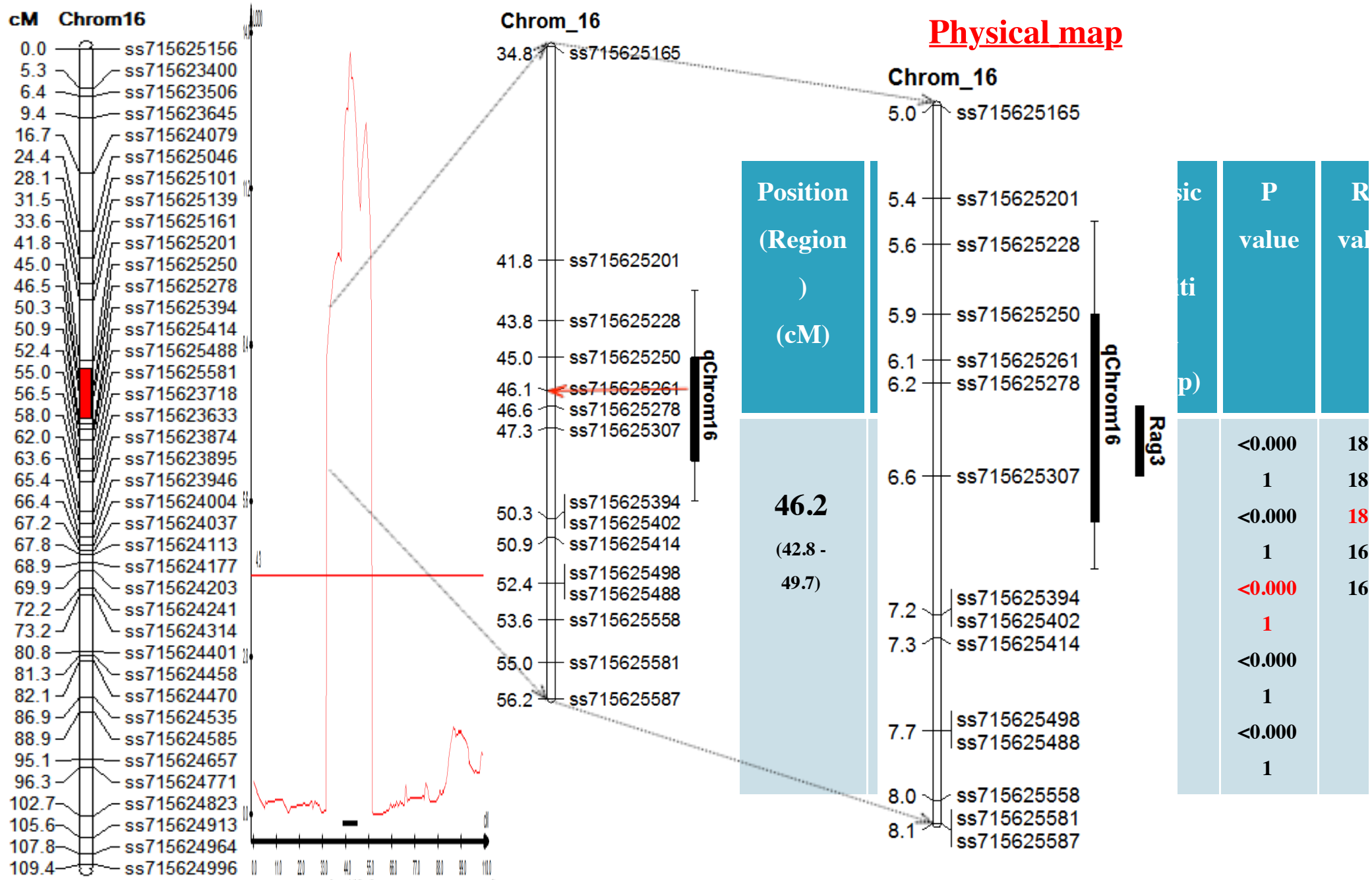
Location of resistant locus on chromosome 7



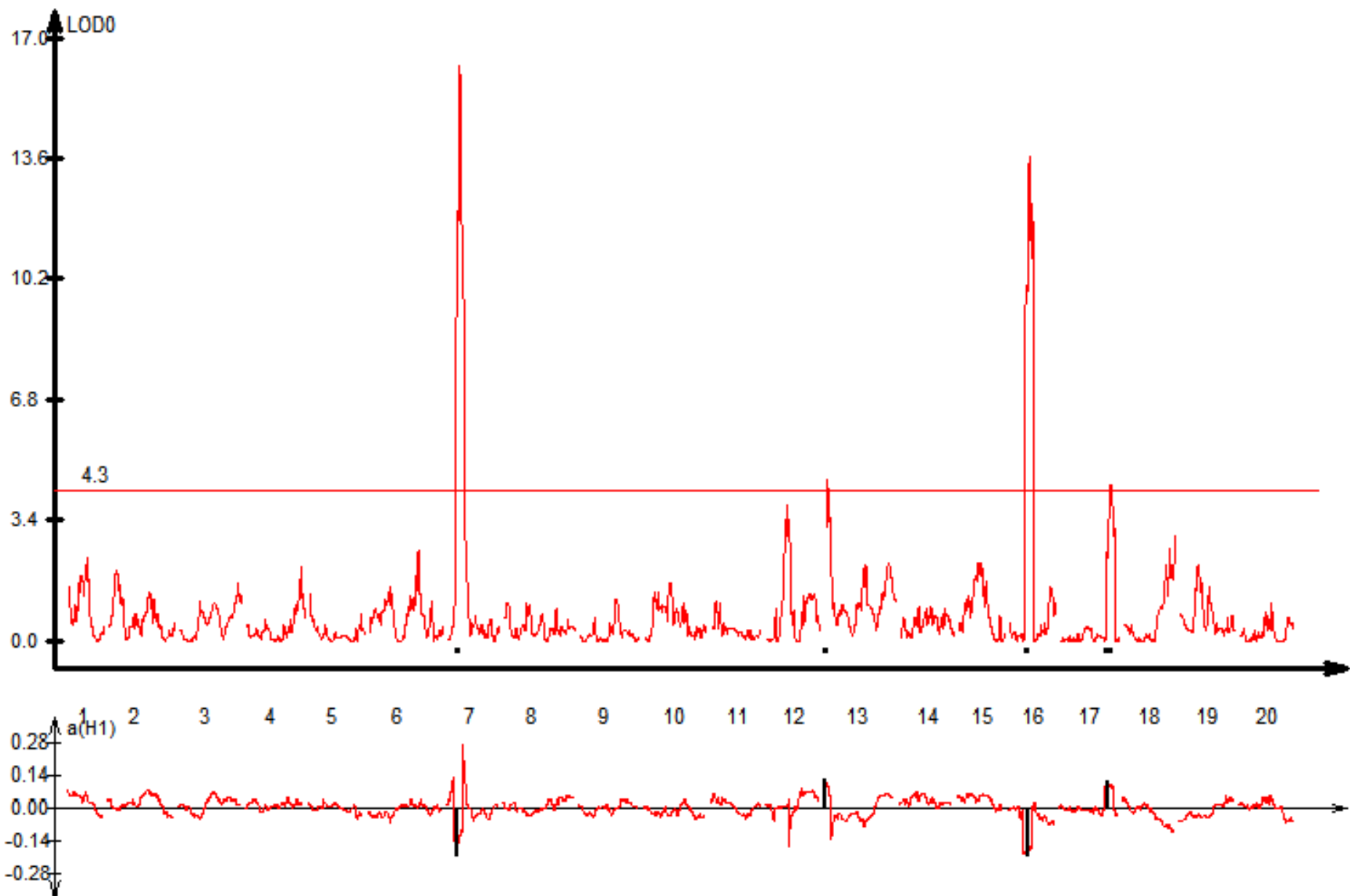
Segregation analysis: **Chromosome 16 locus**



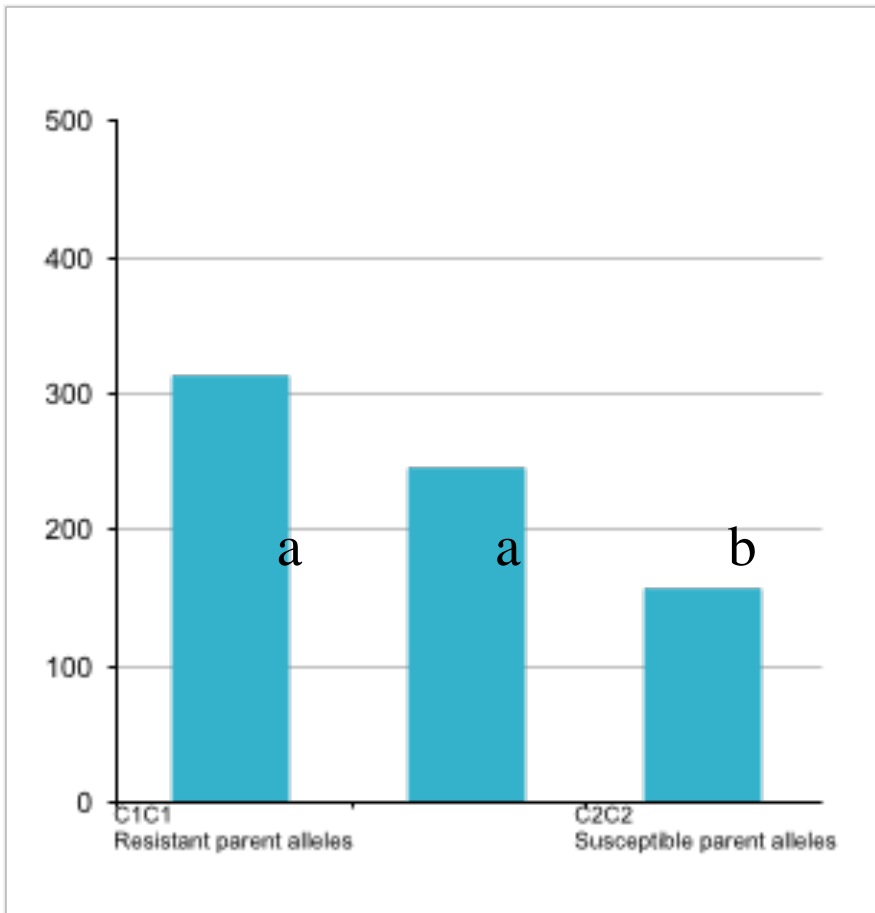
Location of resistant locus on chromosome 16



QTL Mapping



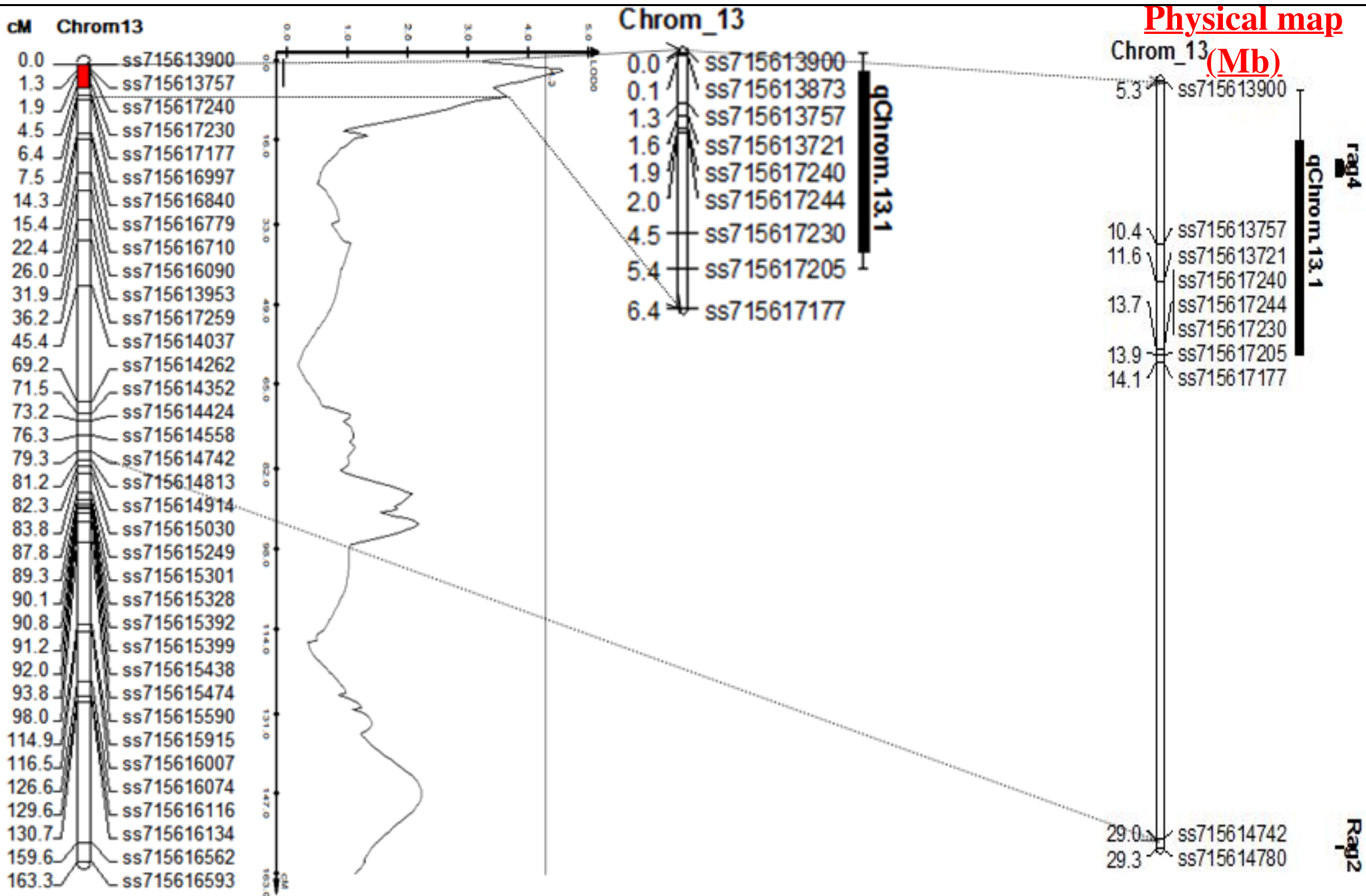
Segregation analysis: **Chromosome 13 and 17 loci**



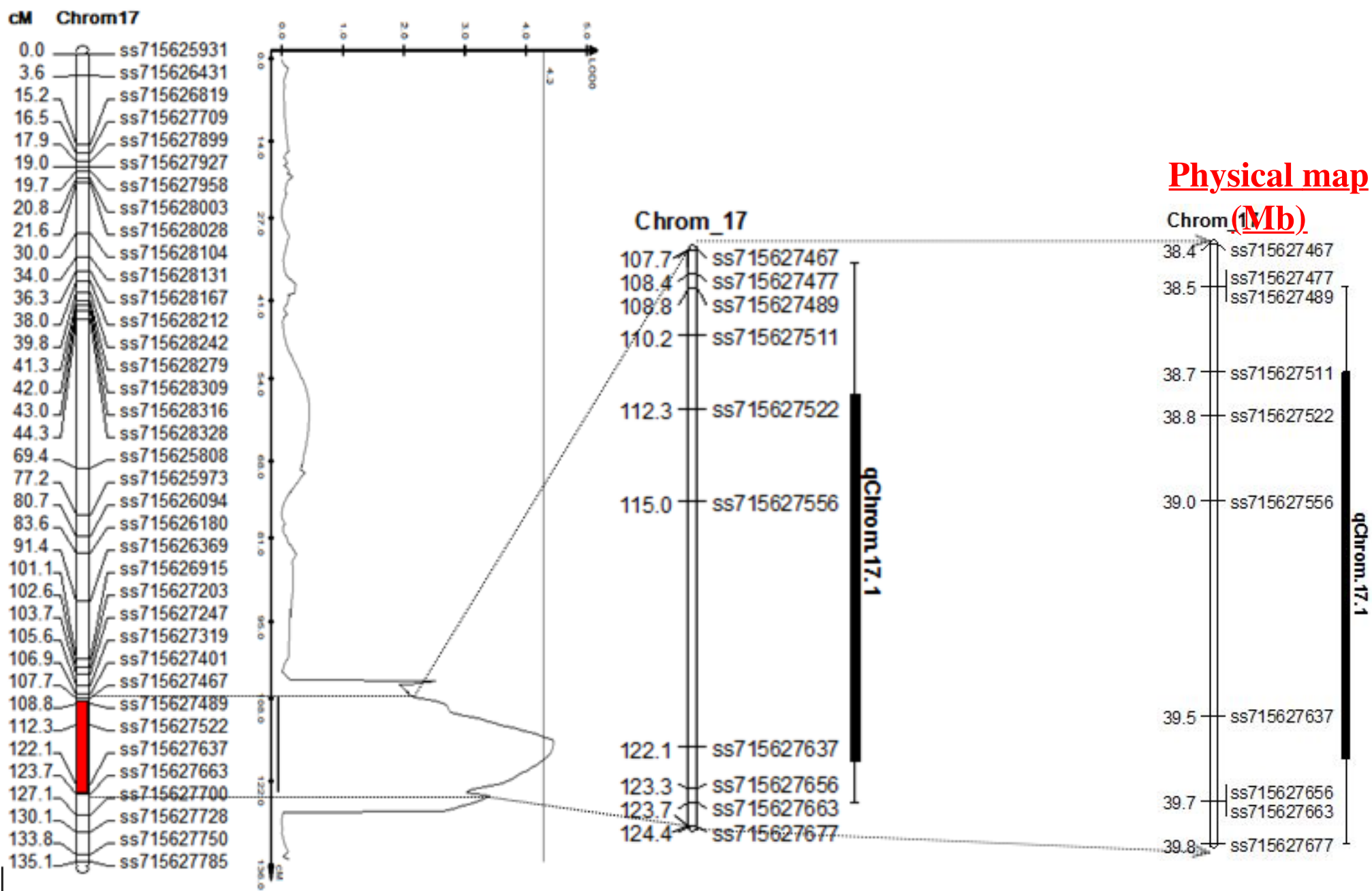
a a b



Location of susceptibility locus on chromosome 13



Location of susceptibility locus on chromosome 17



Conclusions

We identified several early maturing soybean germplasm accessions with different levels of resistance against soybean aphid

**Resistant accessions: PI 603712 (MG 0),
PI 567250A and PI 603339A (MG I)**

**Moderately Resistant accessions: PI 430491 (MG 00)
PI 153214 and PI 437075 (MG I)**

PI 603712 carries oligogenic resistance against soybean aphid with two loci on chrom_07 and chromo_16.

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