

Rhg1 (https://www.gephebase.org/search-criteria?/and+GeneGephebase=~Rhg1^#gephebase-summary-title)	Gephebase Gene	GP00002049	GepelD
Published	Entry Status	Courtier	Main curator

Trait Category		Trait		Trait State in Taxon A		Trait State in Taxon B		Ancestral State		Taxonomic Status	
Physiology (https://www.gephebase.org/search-criteria?/and+Trait+Category=^Physiology^#gephebase-summary-title)		Pathogen resistance (cyst nematode) (https://www.gephebase.org/search-criteria?/and+Trait=^Pathogen resistance (cyst nematode)^#gephebase-summary-title)		Glycine max - sensitive		Glycine max - resistant - Rhg1a haplotype - "Peking-type" low-copy number; three or fewer Rhg1 repeats		Taxon A		Intraspecific (https://www.gephebase.org/search-criteria?/and+Taxonomic+Status=^Intraspecific^#gephebase-summary-title)	
Taxon A		Taxon B		Taxon A		Taxon B		Taxon A		Taxon B	
Glycine max		Glycine max		Glycine max		Glycine max		Glycine max		Glycine max	
(https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=^Glycine+max^#gephebase-summary-title)		(https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=^Glycine+max^#gephebase-summary-title)		(https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=^Glycine+max^#gephebase-summary-title)		(https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=^Glycine+max^#gephebase-summary-title)		(https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=^Glycine+max^#gephebase-summary-title)		(https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=^Glycine+max^#gephebase-summary-title)	
soybean		soybean		soybean		soybean		soybean		soybean	
soybean; soybeans; Glycine max (L.) Merr.; Glycine max; cv. Wye		soybean; soybeans; Glycine max (L.) Merr.; Glycine max; cv. Wye		soybean; soybeans; Glycine max (L.) Merr.; Glycine max; cv. Wye		soybean; soybeans; Glycine max (L.) Merr.; Glycine max; cv. Wye		soybean; soybeans; Glycine max (L.) Merr.; Glycine max; cv. Wye		soybean; soybeans; Glycine max (L.) Merr.; Glycine max; cv. Wye	
species		species		species		species		species		species	
cellular organisms; Eukaryota; Viridiplantae; Streptophyta; Streptophytina; Embryophyta; Tracheophyta; Euphyllophyta; Spermatophyta; Magnoliophyta; Mesangiospermae; eudicotyledons; Gunneridae; Pentapetales; rosids; fabids; Fabales; Fabaceae; Papilionoideae; 50 kb inversion clade; NPAAA clade; indigoferoid/millettioid clade; Phaseoleae; Glycine; Soja		cellular organisms; Eukaryota; Viridiplantae; Streptophyta; Streptophytina; Embryophyta; Tracheophyta; Euphyllophyta; Spermatophyta; Magnoliophyta; Mesangiospermae; eudicotyledons; Gunneridae; Pentapetales; rosids; fabids; Fabales; Fabaceae; Papilionoideae; 50 kb inversion clade; NPAAA clade; indigoferoid/millettioid clade; Phaseoleae; Glycine; Soja		cellular organisms; Eukaryota; Viridiplantae; Streptophyta; Streptophytina; Embryophyta; Tracheophyta; Euphyllophyta; Spermatophyta; Magnoliophyta; Mesangiospermae; eudicotyledons; Gunneridae; Pentapetales; rosids; fabids; Fabales; Fabaceae; Papilionoideae; 50 kb inversion clade; NPAAA clade; indigoferoid/millettioid clade; Phaseoleae; Glycine; Soja		cellular organisms; Eukaryota; Viridiplantae; Streptophyta; Streptophytina; Embryophyta; Tracheophyta; Euphyllophyta; Spermatophyta; Magnoliophyta; Mesangiospermae; eudicotyledons; Gunneridae; Pentapetales; rosids; fabids; Fabales; Fabaceae; Papilionoideae; 50 kb inversion clade; NPAAA clade; indigoferoid/millettioid clade; Phaseoleae; Glycine; Soja		cellular organisms; Eukaryota; Viridiplantae; Streptophyta; Streptophytina; Embryophyta; Tracheophyta; Euphyllophyta; Spermatophyta; Magnoliophyta; Mesangiospermae; eudicotyledons; Gunneridae; Pentapetales; rosids; fabids; Fabales; Fabaceae; Papilionoideae; 50 kb inversion clade; NPAAA clade; indigoferoid/millettioid clade; Phaseoleae; Glycine; Soja		cellular organisms; Eukaryota; Viridiplantae; Streptophyta; Streptophytina; Embryophyta; Tracheophyta; Euphyllophyta; Spermatophyta; Magnoliophyta; Mesangiospermae; eudicotyledons; Gunneridae; Pentapetales; rosids; fabids; Fabales; Fabaceae; Papilionoideae; 50 kb inversion clade; NPAAA clade; indigoferoid/millettioid clade; Phaseoleae; Glycine; Soja	
Soja () - (Rank: subgenus)		Soja () - (Rank: subgenus)		Soja () - (Rank: subgenus)		Soja () - (Rank: subgenus)		Soja () - (Rank: subgenus)		Soja () - (Rank: subgenus)	
(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=1462606)		(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=1462606)		(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=1462606)		(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=1462606)		(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=1462606)		(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=1462606)	
NCBI Taxonomy ID		NCBI Taxonomy ID		NCBI Taxonomy ID		NCBI Taxonomy ID		NCBI Taxonomy ID		NCBI Taxonomy ID	
3847		3847		3847		3847		3847		3847	
(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=3847)		(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=3847)		(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=3847)		(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=3847)		(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=3847)		(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=3847)	
is Taxon A an Intraspecies?		is Taxon B an Intraspecies?		is Taxon A an Intraspecies?		is Taxon B an Intraspecies?		is Taxon A an Intraspecies?		is Taxon B an Intraspecies?	
No		No		No		No		No		No	

rhg1s	Generic Gene Name	UniProtKB Glycine max
	Synonyms	Q8L3Y5 (http://www.uniprot.org/uniprot/Q8L3Y5)
Rfs2; Rhg1; rhg1g	String	GenebankID or UniProtKB
-		JN597009 (https://www.ncbi.nlm.nih.gov/nuccore/JN597009)
-	Sequence Similarities	
	GO - Molecular Function	
	GO:0005524 : ATP binding (https://www.ebi.ac.uk/QuickGO/term/GO:0005524)	
	GO:0004672 : protein kinase activity (https://www.ebi.ac.uk/QuickGO/term/GO:0004672)	
	GO - Biological Process	
-		
	GO - Cellular Component	
	GO:0016021 : integral component of membrane (https://www.ebi.ac.uk/QuickGO/term/GO:0016021)	

No (https://www.gephebase.org/search-criteria?/and+Presumptive Null=^No^#gephebase-summary-title)	Presumptive Null
Cis-regulatory (https://www.gephebase.org/search-criteria?/and+Molecular Type=^Cis-regulatory^#gephebase-summary-title)	Molecular Type
Insertion (https://www.gephebase.org/search-criteria?/and+Aberration Type=^Insertion^#gephebase-summary-title)	Aberration Type
1-10 kb	Insertion Size
Molecular Details of the Mutation	
insertion of a copia retrotransposon within the gene Rhg1 Glyma.18G022500 (Î±-SNAP-encoding). This transposable element is intact and resides within intron 1; anti-sense to the rhg1-a Î±-SNAP open reading frame.	
Experimental Evidence	
Linkage Mapping (https://www.gephebase.org/search-criteria?/and+Experimental Evidence=^Linkage Mapping^#gephebase-summary-title)	
Main Reference	
The rhg1-a (Rhg1 low-copy) nematode resistance source harbors a copia-family retrotransposon within the Rhg1-encoded Î±-SNAP gene. (2019) (https://pubmed.ncbi.nlm.nih.gov/31468029)	
Authors	
Bayless AM; Zapotocny RW; Han S; Grunwald DJ; Amundson KK; Bent AF	
Abstract	
Soybean growers widely use the Resistance to Heterodera glycines 1 (Rhg1) locus to reduce yield losses caused by soybean cyst nematode (SCN). Rhg1 is a tandemly repeated four gene block. Two classes of SCN resistance-conferring Rhg1 haplotypes are recognized: rhg1-a (“Peking-type,” low-copy number, three or fewer Rhg1 repeats) and rhg1-b (“PI 88788-type,” high-copy number, four or more Rhg1 repeats). The rhg1-a and rhg1-b haplotypes encode Î±-SNAP (alpha-Soluble NSF Attachment Protein) variants Î±-SNAP LC and Î±-SNAP HC, respectively, with differing atypical C-terminal domains, that contribute to SCN resistance. Here we report that rhg1-a soybean accessions harbor a copia retrotransposon within their Rhg1 Glyma.18G022500 (Î±-SNAP-encoding) gene. We termed this retrotransposon “RAC,” for Rhg1 alpha-SNAP copia. Soybean carries multiple RAC-like retrotransposon sequences. The Rhg1 RAC insertion is in the Glyma.18G022500 genes of all true rhg1-a haplotypes we tested and was not detected in any examined rhg1-b or Rhg1 (single-copy) soybeans. RAC is an intact element residing within intron 1, anti-sense to the rhg1-a Î±-SNAP open reading frame. RAC has intrinsic promoter activities, but overt impacts of RAC on transgenic Î±-SNAP LC mRNA and protein abundance were not detected. From the native rhg1-a RAC genomic context, elevated Î±-SNAP LC protein abundance was observed in syncytium cells, as was previously observed for Î±-SNAP HC (whose rhg1-b does not carry RAC). Using a SoySNP50K SNP corresponding with RAC presence, just ~42% of USDA accessions bearing previously identified rhg1-a SoySNP50K SNP signatures harbor the RAC insertion. Subsequent analysis of several of these putative rhg1-a accessions lacking RAC revealed that none encoded Î±-SNAPLC, and thus, they are not rhg1-a. rhg1-a haplotypes are of rising interest, with Rhg4, for combating SCN populations that exhibit increased virulence against the widely used rhg1-b resistance. The present study reveals another unexpected structural feature of many Rhg1 loci, and a selectable feature that is predictive of rhg1-a haplotypes.	
Additional References	

RELATED GEPHE

Related Genes	
1 (Rgh4) (https://www.gephebase.org/search-criteria?/or+Taxon ID=^3847^/and+Trait=Pathogen resistance/and+groupHaplotypes=true#gephebase-summary-title)	
Related Haplotypes	
1 (https://www.gephebase.org/search-criteria?/or+Gene Gephebase=^Rhg1^/and+Taxon ID=^3847^/or+Gene Gephebase=^Rhg1^/and+Taxon ID=^3847^#gephebase-summary-title)	

EXTERNAL LINKS

COMMENTS

@TE @Epistasis - The rhg1â€™a resistance is bolstered by an unlinked chromosome 8 locus; Rhg4; whose presence contributes to fullâ€™strength â€™Pekingâ€™typeâ€™ soybean cyst nematode resistance.