GEPHE SUMMARY

Gephebase Gene

Chitin synthase 1 (CHS1) (https://www.gephebase.org/search-criteria?/and+Gene Gephebase=^Chitin synthase 1 (CHS1)^#gephebase-summary-title)

GepheID

GP00001602

Entry Status

Published

Main curator

Prigent

PHENOTYPIC CHANGE

Trait Category

Physiology (https://www.gephebase.org/search-criteria?/and+Trait Category=^Physiology^#gephebase-summary-title)

Trait

Xenobiotic resistance (insecticide; etoxazole acaricide) (https://www.gephebase.org/search-criteria?/and+Trait=^Xenobiotic resistance (insecticide; etoxazole acaricide)^#gephebase-summary-title)

Trait State in Taxon A

spider mite Tetranychus urticae susceptible

Trait State in Taxon B

spider mite Tetranychus urticae strain HexR and strain005 hexythiazox clofentezine and etoxazole-resistant

Ancestral State

Unknown

Taxonomic Status

Intraspecific (https://www.gephebase.org/search-criteria?/and+Taxonomic Status=^Intraspecific^#gephebase-summary-title)

Taxon A

Latin Name

Tetranychus urticae (https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=^Tetranychus urticae^#gephebase-summary-title)

Common Name

two-spotted spider mite

Synonyms

two-spotted spider mite; red spider mite; twospotted mite; Tetranychus urticae Koch, 1836

Rank

species

Lineage

cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Protostomia; Ecdysozoa; Panarthropoda; Arthropoda; Chelicerata; Arachnida; Acari; Acariformes; Trombidiformes; Prostigmata; Eleutherengona; Raphignathae; Tetranychoidea; Tetranychidae; Tetranychus

Parent

Tetranychus () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 32263)

NCBI Taxonomy ID

32264 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 32264)

is Taxon A an Infraspecies?

Yes

Taxon A Description

spider mite Tetranychus urticae susceptible

Taxon B

Latin Name

Tetranychus urticae (https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=^Tetranychus urticae^#gephebase-summary-title)

Common Name

two-spotted spider mite

Synonyms

two-spotted spider mite; red spider mite; twospotted mite; Tetranychus urticae Koch, 1836

Rank

species

Lineage

cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Protostomia; Ecdysozoa; Panarthropoda; Arthropoda; Chelicerata; Arachnida; Acari; Acariformes; Trombidiformes; Prostigmata; Eleutherengona; Raphignathae; Tetranychoidea; Tetranychidae; Tetranychus

Parent

Tetranychus () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 32263)

NCBI Taxonomy ID

32264 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 32264)

is Taxon B an Infraspecies?

Yes

Taxon B Description

spider mite Tetranychus urticae strain HexR and strain005 hexythiazox clofentezine and etoxazole-resistant

GENOTYPIC CHANGE

Generic Gene Name

chs1

Synonyms

chs1; 107359084

String

-

Sequence Similarities

-

GO - Molecular Function

GO:0004100 : chitin synthase activity (https://www.ebi.ac.uk/QuickGO/term/GO:0004100)

GO - Biological Process

-

UniProtKB Tetranychus urticae

H9U0G2 (http://www.uniprot.org/uniprot/H9U0G2)

GenebankID or UniProtKB

()

GO - Cellular Component

GO:0016021 : integral component of membrane
(https://www.ebi.ac.uk/QuickGO/term/GO:0016021)

Presumptive Null

No (https://www.gephebase.org/search-criteria?/and+Presumptive Null=^No^#gephebase-summary-title)

Molecular Type

Coding (https://www.gephebase.org/search-criteria?/and+Molecular Type=^Coding^#gephebase-summary-title)

Aberration Type

SNP (https://www.gephebase.org/search-criteria?/and+Aberration Type=^SNP^#gephebase-summary-title)

SNP Coding Change

Nonsynonymous

Molecular Details of the Mutation

A>T p.I1017F (I1056 in D. melanogaster) located in the C-terminal transmembrane domain

Experimental Evidence

Linkage Mapping (https://www.gephebase.org/search-criteria?/and+Experimental Evidence=^Linkage Mapping^#gephebase-summary-title)

	Taxon A	Taxon B	Position
Codon	-	-	-
Amino-acid	-	-	-

Main Reference

High resolution genetic mapping uncovers chitin synthase-1 as the target-site ofÂ the structurally diverse mite growth inhibitors clofentezine, hexythiazox and etoxazole in Tetranychus urticae. (2014) (https://pubmed.ncbi.nlm.nih.gov/24859419)

Authors

Demaeght P; Osborne EJ; Odman-Naresh J; GrbiÄ‡ M; Nauen R; Merzendorfer H; Clark RM; Van Leeuwen T

Abstract

The acaricides clofentezine, hexythiazox and etoxazole are commonly referred to as 'mite growth inhibitors', and clofentezine and hexythiazox have been used successfully for the integrated control of plant mite pests for decades. Although they are still important today, their mode of action has remained elusive. Recently, a mutation in chitin synthase 1 (CHS1) was linked to etoxazole resistance. In this study, we identified and investigated a Tetranychus urticae strain (HexR) harboring recessive, monogenic resistance to each of hexythiazox, clofentezine, and etoxazole. To elucidate if there is a common genetic basis for the observed cross-resistance, we adapted a previously developed bulk segregant analysis method to map with high resolution a single, shared resistance locus for all three compounds. This finding indicates that the underlying molecular basis for resistance to all three compounds is identical. This locus is centered on the CHS1 gene, and as supported by additional genetic and biochemical studies, a non-synonymous variant (I1017F) in CHS1 associates with resistance to each of the tested acaricides in HexR. Our findings thus demonstrate a shared molecular mode of action for the chemically diverse mite growth inhibitors clofentezine, hexythiazox and etoxazole as inhibitors of an essential, non-catalytic activity of CHS1. Given the previously documented cross-resistance between clofentezine, hexythiazox and the benzyolphenylurea (BPU) compounds flufenoxuron and cycloxuron, CHS1 should be also considered as a potential target-site of insecticidal BPUs.

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Additional References

Population bulk segregant mapping uncovers resistance mutations and the mode of action of a chitin synthesis inhibitor in arthropods. (2012) (https://pubmed.ncbi.nlm.nih.gov/22393009)

RELATED GEPHE

Related Genes

8 (Acetylcholinesterase (Ace-1), CPR, CYP392A16, CYP392E8, cytochrome b, glutamate-gated chloride channel (GluCl), para (kdr), PSST) (https://www.gephebase.org/search-criteria?/or+Taxon ID=^32264^/and+Trait=Xenobiotic resistance/and+groupHaplotypes=true#gephebase-summary-title)

Related Haplotypes

No matches found.

EXTERNAL LINKS

COMMENTS

Observed pattern is indicative of recurrent mutation and selection in EtoxR and Strain005. Transgenic flies with the same mutation is highly resistant to etoxazole and all tested benzoylureas as well as buprofezin