

GEPHE SUMMARY

<p>RYR (#Gephebase-ryr)</p> <p>Published</p>	<p>Gephebase Gene</p> <p>Entry Status</p>	<p>GP00002436</p> <p>Courtier</p>	<p>GepheID</p> <p>Main curator</p>
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PHENOTYPIC CHANGE

<p>Physiology (#Gephebase-physiology)</p> <p>Xenobiotic resistance (insecticide ; diamide) (#Gephebase-xenobiotic-resistance)</p> <p>tomato leafminer <i>Tuta absoluta</i> - susceptible</p> <p>tomato leafminer <i>Tuta absoluta</i> - Brazilian resistant strain BR-PSQ</p> <p>Taxon A</p> <p>Intraspecific (#Gephebase-intraspecific)</p>	<p>Trait Category</p> <p>Trait</p> <p>Trait State in Taxon A</p> <p>Trait State in Taxon B</p> <p>Ancestral State</p> <p>Taxonomic Status</p>	<p>tomato leafminer <i>Tuta absoluta</i> - susceptible</p> <p>tomato leafminer <i>Tuta absoluta</i> - Brazilian resistant strain BR-PSQ</p> <p>Taxon B</p> <p>Intraspecific (#Gephebase-intraspecific)</p>	<p>Physiology (#Gephebase-physiology)</p> <p>Xenobiotic resistance (insecticide ; diamide) (#Gephebase-xenobiotic-resistance)</p> <p>tomato leafminer <i>Tuta absoluta</i> - susceptible</p> <p>tomato leafminer <i>Tuta absoluta</i> - Brazilian resistant strain BR-PSQ</p> <p>Taxon A</p> <p>Intraspecific (#Gephebase-intraspecific)</p>	<p>Trait Category</p> <p>Trait</p> <p>Trait State in Taxon A</p> <p>Trait State in Taxon B</p> <p>Ancestral State</p> <p>Taxonomic Status</p>	<p>tomato leafminer <i>Tuta absoluta</i> - susceptible</p> <p>tomato leafminer <i>Tuta absoluta</i> - Brazilian resistant strain BR-PSQ</p> <p>Taxon B</p> <p>Intraspecific (#Gephebase-intraspecific)</p>
<p><i>Tuta absoluta</i> (#Gephebase-tuta-absoluta)</p> <p>-</p> <p>Gnorimoschema absoluta; Phthorimaea absoluta; Scrobipalpula absoluta; Scrobipalpuloides absoluta; <i>Tuta absoluta</i> (Meyrick, 1917)</p> <p>species</p> <p>cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Protostomia; Ecdysozoa; Panarthropoda; Arthropoda; Mandibulata; Pancrustacea; Hexapoda; Insecta; Dicondylia; Pterygota; Neoptera; Holometabola; Amphimesnoptera; Lepidoptera; Glossata; Neolepidoptera; Heteroneura; Ditytsia; Gelechioidea; Gelechiidae; Gelechiinae; <i>Tuta</i></p> <p><i>Tuta</i> () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=702716)</p> <p>702717 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=702717)</p> <p>No</p>	<p>Latin Name</p> <p>Common Name</p> <p>Synonyms</p> <p>Rank</p> <p>Lineage</p> <p>Parent</p> <p>NCBI Taxonomy ID</p> <p>is Taxon A an Intraspecies?</p>	<p><i>Tuta absoluta</i> (#Gephebase-tuta-absoluta)</p> <p>-</p> <p>Gnorimoschema absoluta; Phthorimaea absoluta; Scrobipalpula absoluta; Scrobipalpuloides absoluta; <i>Tuta absoluta</i> (Meyrick, 1917)</p> <p>species</p> <p>cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Protostomia; Ecdysozoa; Panarthropoda; Arthropoda; Mandibulata; Pancrustacea; Hexapoda; Insecta; Dicondylia; Pterygota; Neoptera; Holometabola; Amphimesnoptera; Lepidoptera; Glossata; Neolepidoptera; Heteroneura; Ditytsia; Gelechioidea; Gelechiidae; Gelechiinae; <i>Tuta</i></p> <p><i>Tuta</i> () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=702716)</p> <p>702717 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=702717)</p> <p>No</p>	<p>Latin Name</p> <p>Common Name</p> <p>Synonyms</p> <p>Rank</p> <p>Lineage</p> <p>Parent</p> <p>NCBI Taxonomy ID</p> <p>is Taxon B an Intraspecies?</p>		

GENOTYPIC CHANGE

<p>RyR</p> <p>RyR; CG10844; D-RyR; Dmel\CG10844; DmRyR; DRR; dry; DRY; dRyR; dRyR; dya; l(2)k00424; l(2)k04913; Rya-44F; Rya-r4; rya-r44F; Rya-r44F; Rya-R44F; Rya-r76CD; ryr; RYR; RyRs</p> <p>7227.FBpp0293114 (http://string-db.org/newstring.cgi/show_network_section.pl?identifier=7227.FBpp0293114)</p> <p>Belongs to the ryanodine receptor (TC 1.A.3.1) family.</p> <p>GO:0005509 : calcium ion binding (https://www.ebi.ac.uk/QuickGO/term/GO:0005509)</p> <p>GO:0048763 : calcium-induced calcium release activity</p>	<p>Generic Gene Name</p> <p>Synonyms</p> <p>String</p> <p>Sequence Similarities</p> <p>GO - Molecular Function</p>	<p>Q24498 (http://www.uniprot.org/uniprot/Q24498)</p> <p>()</p>	<p>UniProtKB <i>Drosophila melanogaster</i></p> <p>GenebankID or UniProtKB</p>
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(<https://www.ebi.ac.uk/QuickGO/term/GO:0048763>)
 GO:0005219 : ryanodine-sensitive calcium-release channel activity
 (<https://www.ebi.ac.uk/QuickGO/term/GO:0005219>)

GO - Biological Process

GO:0006874 : cellular calcium ion homeostasis
 (<https://www.ebi.ac.uk/QuickGO/term/GO:0006874>)
 GO:0035206 : regulation of hemocyte proliferation
 (<https://www.ebi.ac.uk/QuickGO/term/GO:0035206>)
 GO:0006936 : muscle contraction (<https://www.ebi.ac.uk/QuickGO/term/GO:0006936>)
 GO:0006816 : calcium ion transport (<https://www.ebi.ac.uk/QuickGO/term/GO:0006816>)
 GO:0060047 : heart contraction (<https://www.ebi.ac.uk/QuickGO/term/GO:0060047>)
 GO:0072347 : response to anesthetic (<https://www.ebi.ac.uk/QuickGO/term/GO:0072347>)

GO - Cellular Component

GO:0016021 : integral component of membrane
 (<https://www.ebi.ac.uk/QuickGO/term/GO:0016021>)
 GO:0030659 : cytoplasmic vesicle membrane
 (<https://www.ebi.ac.uk/QuickGO/term/GO:0030659>)
 GO:0030018 : Z disc (<https://www.ebi.ac.uk/QuickGO/term/GO:0030018>)
 GO:0042383 : sarcolemma (<https://www.ebi.ac.uk/QuickGO/term/GO:0042383>)
 GO:0033017 : sarcoplasmic reticulum membrane
 (<https://www.ebi.ac.uk/QuickGO/term/GO:0033017>)
 GO:0005790 : smooth endoplasmic reticulum
 (<https://www.ebi.ac.uk/QuickGO/term/GO:0005790>)

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

G4903 corresponds to the G4946E mutation site shown to confer diamide resistance in diamondback moth

Experimental Evidence

Candidate Gene (<https://www.gephebase.org/search-criteria?/and+Experimental Evidence=^Candidate Gene^#gephebase-summary-title>)

	Taxon A	Taxon B	Position
Codon	GGG	GAG	-
Amino-acid	Gly	Glu	4946

Main Reference

Ryanodine receptor point mutations confer diamide insecticide resistance in tomato leafminer, *Tuta absoluta* (Lepidoptera: Gelechiidae). (2017) (<https://pubmed.ncbi.nlm.nih.gov/27845250>)

Authors

Roditakis E; Steinbach D; Moritz G; Vasakis E; Stavrakaki M; Ilias A; Garc a-Vidal L; Mart nez-Aguirre MDR; Bielza P; Morou E; Silva JE; Silva WM; Siqueira  -AA; Iqbal S; Troczka BJ; Williamson MS; Bass C; Tsagakou A; Vontas J; Nauen R

Abstract

Insect ryanodine receptors (RyR) are the molecular target-site for the recently introduced diamide insecticides. Diamides are particularly active on Lepidoptera pests, including tomato leafminer, *Tuta absoluta* (Lepidoptera: Gelechiidae). High levels of diamide resistance were recently described in some European populations of *T. absoluta*, however, the mechanisms of resistance remained unknown. In this study the molecular basis of diamide resistance was investigated in a diamide resistant strain from Italy (IT-GELA-SD4), and additional resistant field populations collected in Greece, Spain and Brazil. The genetics of resistance was investigated by reciprocally crossing strain IT-GELA-SD4 with a susceptible strain and revealed an autosomal incompletely recessive mode of inheritance. To investigate the possible role of target-site mutations as known from diamondback moth (*Plutella xylostella*), we sequenced respective domains of the RyR gene of *T. absoluta*. Genotyping of individuals of IT-GELA-SD4 and field-collected strains showing different levels of diamide resistance revealed the presence of G4903E and I4746M RyR target-site mutations. These amino acid substitutions correspond to those recently described for diamide resistant diamondback moth, i.e. G4946E and I4790M. We also detected two novel mutations, G4903V and I4746T, in some of the resistant *T. absoluta* strains. Radioligand binding studies with thoracic membrane preparations of the IT-GELA-SD4 strain provided functional evidence that these mutations alter the affinity of the RyR to diamides. In combination with previous work on *P. xylostella* our study highlights the importance of position G4903 (G4946 in *P. xylostella*) of the insect RyR in defining sensitivity to diamides. The discovery of diamide resistance mutations in *T. absoluta* populations of diverse geographic origin has serious implications for the efficacy of diamides under applied conditions. The implementation of appropriate resistance management strategies is strongly advised to delay the further spread of resistance.

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Additional References

Investigation of the contribution of RyR target-site mutations in diamide resistance by CRISPR/Cas9 genome modification in *Drosophila*. (2017) (<https://pubmed.ncbi.nlm.nih.gov/28669775>)

RELATED GEPHE

Related Genes

2 (nAChR, para (kdr)) (<https://www.gephebase.org/search-criteria?/or+Taxon ID=^702717^/and+Trait=Xenobiotic resistance/and+groupHaplotypes=true#gephebase-summary-title>)

Related Haplotypes

3 (<https://www.gephebase.org/search-criteria?/or+Gene Gephebase=^RyR^/and+Taxon ID=^702717^/or+Gene Gephebase=^RyR^/and+Taxon ID=^702717^#gephebase-summary-title>)

EXTERNAL LINKS

COMMENTS

@Parallelism - independent evolution of the same amino acid substitution (but different codon changes GGG>GAG and GGG>GAA) in different Brazilian Tuta absoluta field strains