

GEPHE SUMMARY

<p>RYR (https://www.gephebase.org/search-criteria?/and+Gene+Gephebase+RYR+Gephebase-summary-title)</p> <p>Published</p>	<p>Gephebase Gene</p> <p>Entry Status</p>	<p>GP00002439</p> <p>Courtier</p>	<p>GepheID</p> <p>Main curator</p>
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PHENOTYPIC CHANGE

<p>Physiology (https://www.gephebase.org/search-criteria?/and+Trait+Category+Physiology+Gephebase-summary-title)</p> <p>Xenobiotic resistance (insecticide ; diamide) (https://www.gephebase.org/search-criteria?/and+Trait+Xenobiotic+resistance+insecticide+diamide+Gephebase-summary-title)</p> <p>tomato leafminer <i>Tuta absoluta</i> - susceptible</p> <p>tomato leafminer <i>Tuta absoluta</i> - resistant strain GR-IER-SD originating from Crete in Greece and obtained after four sequential selections of field populations with flubendiamide</p> <p>Taxon A</p> <p>Intraspecific (https://www.gephebase.org/search-criteria?/and+Taxonomic+Status+Intraspecific+Gephebase-summary-title)</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> - resistant strain GR-IER-SD originating from Crete in Greece and obtained after four sequential selections of field populations with flubendiamide</p> <p>Taxon A</p> <p>Intraspecific (https://www.gephebase.org/search-criteria?/and+Taxonomic+Status+Intraspecific+Gephebase-summary-title)</p>	<p>Physiology (https://www.gephebase.org/search-criteria?/and+Trait+Category+Physiology+Gephebase-summary-title)</p> <p>Xenobiotic resistance (insecticide ; diamide) (https://www.gephebase.org/search-criteria?/and+Trait+Xenobiotic+resistance+insecticide+diamide+Gephebase-summary-title)</p> <p>tomato leafminer <i>Tuta absoluta</i> - susceptible</p> <p>tomato leafminer <i>Tuta absoluta</i> - resistant strain GR-IER-SD originating from Crete in Greece and obtained after four sequential selections of field populations with flubendiamide</p> <p>Taxon B</p> <p>Intraspecific (https://www.gephebase.org/search-criteria?/and+Taxonomic+Status+Intraspecific+Gephebase-summary-title)</p>
<p><i>Tuta absoluta</i> (https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms+Tuta+absoluta+Gephebase-summary-title)</p> <p>-</p> <p>Gnorimoschema <i>absoluta</i>; Phthorimaea <i>absoluta</i>; Scrobipalpula <i>absoluta</i>; Scrobipalpuloides <i>absoluta</i>; <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; Ditrysia; 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>Taxon A</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 Infrapopulation?</p>	<p><i>Tuta absoluta</i> (https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms+Tuta+absoluta+Gephebase-summary-title)</p> <p>-</p> <p>Gnorimoschema <i>absoluta</i>; Phthorimaea <i>absoluta</i>; Scrobipalpula <i>absoluta</i>; Scrobipalpuloides <i>absoluta</i>; <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; Ditrysia; 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>Taxon B</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 Infrapopulation?</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>Generic Gene Name</p> <p>Synonyms</p> <p>String</p> <p>Sequence Similarities</p> <p>GO - Molecular Function</p>	<p>UniProtKB <i>Drosophila melanogaster</i></p> <p>Q24498 (http://www.uniprot.org/uniprot/Q24498)</p> <p>()</p> <p>GenebankID or UniProtKB</p>
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GO:0048763 : calcium-induced calcium release activity
 (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

I4790M

Experimental Evidence

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

	Taxon A	Taxon B	Position
Codon	ATA	ATG	-
Amino-acid	Ile	Met	4790

Main Reference

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)

Authors

Douris V; Papapostolou KM; Ilias A; Roditakis E; Kounadi S; Riga M; Nauen R; Vontas J

Abstract

Diamide insecticides are used widely against lepidopteran pests, acting as potent activators of insect Ryanodine Receptors (RyRs) and thus inducing muscle contraction and eventually death. However, resistant phenotypes have recently evolved in the field, associated with the emergence of target site resistance mutations (G4946E/V and I4790M). We investigated the frequency of the mutations found in a resistant population of *Tuta absoluta* from Greece (G4946V ~79% and I4790M ~21%) and the associated diamide resistance profile: there are very high levels of resistance against chlorantraniliprole (9329-fold) and flubendiamide (4969-fold), but moderate levels against cyantraniliprole (191-fold). To further investigate functionally the contribution of each mutation in the resistant phenotype, we used CRISPR/Cas9 to generate genome modified *Drosophila* carrying alternative allele combinations, and performed toxicity bioassays against all three diamides. Genome modified flies bearing the G4946V mutation exhibited high resistance ratios to flubendiamide (91.3-fold) and chlorantraniliprole (194.7-fold) when compared to cyantraniliprole (5.4-fold). Flies naturally wildtype for the I4790M mutation were moderately resistant to flubendiamide (15.3-fold) but significantly less resistant to chlorantraniliprole (7.5-fold), and cyantraniliprole (2.3-fold). These findings provide *in vivo* functional genetic confirmation for the role and relative contribution of RyR mutations in diamide resistance and suggest that the mutations confer subtle differences on the relative binding affinities of the three diamides at an overlapping binding site on the RyR protein.

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Additional References

CRISPR/Cas9 mediated ryanodine receptor I4790M knockin confers unequal resistance to diamides in *Plutella xylostella*. (2020) (https://pubmed.ncbi.nlm.nih.gov/32798712)

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=^RYP^/and+Taxon ID=^702717^/or+Gene Gephebase=^RYP^/and+Taxon ID=^702717^#gephebase-summary-title)

EXTERNAL LINKS

COMMENTS

@Parallelism The two mutations found in GR-IER-SD have probably arisen independently since they are always found in different alleles and never in the same chromosome.