

GEPHE SUMMARY

| | | |
|--|----------------|--------------|
| | Gephebase Gene | GephelD |
| resistance to dieldrin (https://www.gephebase.org/search-criteria/?and+Gene Gephebase="resistance to dieldrin">#gephebase-summary-title) | GP00002452 | Main curator |
| | Entry Status | Courtier |
| Published | | |

PHENOTYPIC CHANGE

| | Trait Category | |
|---|---|---|
| Physiology (https://www.gephebase.org/search-criteria/?and+Trait Category="Physiology">#gephebase-summary-title) | Trait | |
| Xenobiotic resistance (insecticide) (https://www.gephebase.org/search-criteria/?and+Trait=^Xenobiotic+resistance+(insecticide)^#gephebase-summary-title) | Trait State in Taxon A | |
| Drosophila melanogaster | Trait State in Taxon B | |
| Drosophila melanogaster - Rdl | Ancestral State | |
| Data not curated | Taxonomic Status | |
| Intraspecific (https://www.gephebase.org/search-criteria/?and+Taxonomic Status="Intraspecific">#gephebase-summary-title) | | |
| Taxon A | | Taxon B |
| | Latin Name | Latin Name |
| Drosophila melanogaster (#gephebase-summary-title) | Drosophila melanogaster (#gephebase-summary-title) | |
| | Common Name | Common Name |
| fruit fly | Synonyms | Synonyms |
| Sophophora melanogaster; fruit fly; Drosophila melanogaster Meigen, 1830; Sophophora melanogaster (Meigen, 1830); Drosophila melangaster | Sophophora melanogaster; fruit fly; Drosophila melanogaster Meigen, 1830; Sophophora melanogaster (Meigen, 1830); Drosophila melangaster | |
| | Rank | Rank |
| species | Lineage | Lineage |
| cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Protostomia; Ecdysozoa; Panarthropoda; Arthropoda; Mandibulata; Pancrustacea; Hexapoda; Insecta; Dicondylia; Pterygota; Neoptera; Holometabola; Diptera; Brachycera; Muscomorpha; Eremoneura; Cyclorrhapha; Schizophora; Acalyptratae; Ephydriodea; Drosophilidae; Drosophilinae; Drosophilini; Drosophila; Sophophora; melanogaster group; melanogaster subgroup | cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Protostomia; Ecdysozoa; Panarthropoda; Arthropoda; Mandibulata; Pancrustacea; Hexapoda; Insecta; Dicondylia; Pterygota; Neoptera; Holometabola; Diptera; Brachycera; Muscomorpha; Eremoneura; Cyclorrhapha; Schizophora; Acalyptratae; Ephydriodea; Drosophilidae; Drosophilinae; Drosophilini; Drosophila; Sophophora; melanogaster group; melanogaster subgroup | |
| | Parent | Parent |
| melanogaster subgroup () - (Rank: species subgroup) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=32351) | melanogaster subgroup () - (Rank: species subgroup) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=32351) | |
| 7227 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=7227) | NCBI Taxonomy ID is Taxon A an Infraspecies? | NCBI Taxonomy ID is Taxon B an Infraspecies? |
| No | | |

GENOTYPIC CHANGE

| | Generic Gene Name | UniProtKB Drosophila melanogaster |
|---|--|-----------------------------------|
| Rdl | Synonyms | |
| CG10537; CT29555; Dmel\CG10537; DmRdl; DmRDL; gaba; GABA; GABA-R; GABA _R ; GABA _A ; GABA _A receptor; GABA _A -R; GABA _A R; LCCH1; Rd1; rdl; RDL | P25123 (http://www.uniprot.org/uniprot/P25123) | GenebankID or UniProtKB |
| | String | |
| 7227.FBpp0305970 (http://string-db.org/newstring_cgi/show_network_section.pl?identifier=7227.FBpp0305970) | Sequence Similarities | |
| Belongs to the ligand-gated ion channel (TC 1.A.9) family. Gamma-aminobutyric acid receptor (TC 1.A.9.5) subfamily. | | |
| GO:0004890 : GABA-A receptor activity (https://www.ebi.ac.uk/QuickGO/term/GO:0004890) | GO - Molecular Function | |

GO:0022851 : GABA-gated chloride ion channel activity

(<https://www.ebi.ac.uk/QuickGO/term/GO:0022851>)

GO:0030594 : neurotransmitter receptor activity

(<https://www.ebi.ac.uk/QuickGO/term/GO:0030594>)

GO - Biological Process

GO:0007165 : signal transduction (<https://www.ebi.ac.uk/QuickGO/term/GO:0007165>)

GO:0007268 : chemical synaptic transmission

(<https://www.ebi.ac.uk/QuickGO/term/GO:0007268>)

GO:0034220 : ion transmembrane transport

(<https://www.ebi.ac.uk/QuickGO/term/GO:0034220>)

GO:0042493 : response to drug (<https://www.ebi.ac.uk/QuickGO/term/GO:0042493>)

GO:0050877 : nervous system process

(<https://www.ebi.ac.uk/QuickGO/term/GO:0050877>)

GO:0042391 : regulation of membrane potential

(<https://www.ebi.ac.uk/QuickGO/term/GO:0042391>)

GO:0006811 : ion transport (<https://www.ebi.ac.uk/QuickGO/term/GO:0006811>)

GO:0042048 : olfactory behavior (<https://www.ebi.ac.uk/QuickGO/term/GO:0042048>)

GO:0030431 : sleep (<https://www.ebi.ac.uk/QuickGO/term/GO:0030431>)

GO:0009612 : response to mechanical stimulus

(<https://www.ebi.ac.uk/QuickGO/term/GO:0009612>)

GO:0002121 : inter-male aggressive behavior

(<https://www.ebi.ac.uk/QuickGO/term/GO:0002121>)

GO:0050805 : negative regulation of synaptic transmission

(<https://www.ebi.ac.uk/QuickGO/term/GO:0050805>)

GO:0042749 : regulation of circadian sleep/wake cycle

(<https://www.ebi.ac.uk/QuickGO/term/GO:0042749>)

GO:0090328 : regulation of olfactory learning

(<https://www.ebi.ac.uk/QuickGO/term/GO:0090328>)

GO - Cellular Component

GO:0016021 : integral component of membrane

(<https://www.ebi.ac.uk/QuickGO/term/GO:0016021>)

GO:0005886 : plasma membrane (<https://www.ebi.ac.uk/QuickGO/term/GO:0005886>)

GO:0005887 : integral component of plasma membrane

(<https://www.ebi.ac.uk/QuickGO/term/GO:0005887>)

GO:0030054 : cell junction (<https://www.ebi.ac.uk/QuickGO/term/GO:0030054>)

GO:0030425 : dendrite (<https://www.ebi.ac.uk/QuickGO/term/GO:0030425>)

GO:0043005 : neuron projection (<https://www.ebi.ac.uk/QuickGO/term/GO:0043005>)

GO:0030424 : axon (<https://www.ebi.ac.uk/QuickGO/term/GO:0030424>)

GO:0045211 : postsynaptic membrane

(<https://www.ebi.ac.uk/QuickGO/term/GO:0045211>)

GO:0045202 : synapse (<https://www.ebi.ac.uk/QuickGO/term/GO:0045202>)

GO:0034707 : chloride channel complex

(<https://www.ebi.ac.uk/QuickGO/term/GO:0034707>)

GO:0032589 : neuron projection membrane

(<https://www.ebi.ac.uk/QuickGO/term/GO:0032589>)

GO:0032809 : neuronal cell body membrane

(<https://www.ebi.ac.uk/QuickGO/term/GO:0032809>)

Presumptive Null

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

Molecular Type

Gene Amplification (<https://www.gephebase.org/search-criteria/?and+Molecular+Type=%Gene+Amplification%#gephebase-summary-title>)

Aberration Type

Insertion (<https://www.gephebase.org/search-criteria/?and+Aberration+Type=%Insertion%#gephebase-summary-title>)

Insertion Size

100-1000 kb

Molecular Details of the Mutation

113-kb duplication containing one WT copy of Rdl and a second copy with two point mutations: an Ala(301) to Ser resistance mutation and Met(360) to Ile replacement. Individuals with this duplication exhibit intermediate dieldrin resistance compared with single copy Ser(301) homozygotes and reduced temperature sensitivity and altered RNA editing associated with the resistant allele. Ectopic recombination between Roo transposable elements is involved in generating this genomic rearrangement. The duplication phenotypes were confirmed by construction of a transgenic artificial duplication integrating the 55.7-kb Rdl locus with a Ser(301) change into an Ala(301) background.

Experimental Evidence

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

Main Reference

Gene duplication in the major insecticide target site, Rdl, in *Drosophila melanogaster*. (2013) (<https://pubmed.ncbi.nlm.nih.gov/23959864>)

Authors

Remnant EJ; Good RT; Schmidt JM; Lumb C; Robin C; Daborn PJ; Batterham P

Abstract

The Resistance to Dieldrin gene, Rdl, encodes a GABA-gated chloride channel subunit that is targeted by cyclodiene and phenylpyrazole insecticides. The gene was first characterized in *Drosophila melanogaster* by genetic mapping of resistance to the cyclodiene dieldrin. The 4,000-fold resistance observed was due to a single amino acid replacement, Ala(301) to Ser. The equivalent change was subsequently identified in Rdl orthologs of a large range of resistant insect species. Here, we report identification of a duplication at the Rdl locus in *D. melanogaster*. The 113-kb duplication contains one WT copy of Rdl and a second copy with two point mutations: an Ala(301) to Ser resistance mutation and Met(360) to Ile replacement. Individuals with this duplication exhibit intermediate dieldrin resistance compared with single copy Ser(301) homozygotes, reduced temperature sensitivity, and altered RNA editing associated with the resistant allele. Ectopic recombination between Roo transposable elements is involved in generating this genomic rearrangement. The duplication phenotypes were confirmed by construction of a transgenic, artificial duplication integrating the 55.7-kb Rdl locus with a Ser(301) change into an Ala(301) background. Gene duplications can contribute significantly to the evolution of insecticide resistance, most commonly by increasing the amount of gene product produced. Here however, duplication of the Rdl target site creates permanent heterozygosity, providing unique potential for adaptive mutations to accrue in one copy, without abolishing the endogenous role of an essential gene.

Additional References

RELATED GEPHE

Related Genes

19 (Acetylcholinesterase (Ace-2), alcohol dehydrogenase (Adh), Aldehyde dehydrogenase (Aldh), CG11699, Cyp12d1, Cyp28d1, Cyp28d1-Cyp28d2, cyp6d2, cyp6g1, glutamate-gated chloride channel (GluCl), GSS (glutathione synthetase), GSTE1-E10 cluster, kin of irre (kire), para (kdr), PHGPx, RnrS, SOD1, Ugt86Dd, CHKov1) ([https://www.gephebase.org/search-criteria?/or+Taxon ID=%277227%27/and+Trait=Xenobiotic resistance/and+groupHaplotypes=true#gephebase-summary-title](https://www.gephebase.org/search-criteria?/or+Taxon%20ID=%277227%27/and+Trait=Xenobiotic%20resistance/and+groupHaplotypes=true#gephebase-summary-title))

Related Haplotypes

2 ([https://www.gephebase.org/search-criteria?/or+Gene Gephebase=%27resistance to dielldrin%27/and+Taxon ID=%277227%27/or+Gene Gephebase=%27resistance to dielldrin%27/and+Taxon ID=%277227%27#gephebase-summary-title](https://www.gephebase.org/search-criteria?/or+Gene%20Gephebase=%27resistance%20to%20dielldrin%27/and+Taxon%20ID=%277227%27/or+Gene%20Gephebase=%27resistance%20to%20dielldrin%27/and+Taxon%20ID=%277227%27#gephebase-summary-title))

EXTERNAL LINKS

COMMENTS

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