

GEPHE SUMMARY

nAChR (https://www.gephebase.org/search-criteria/?and+Gene Gephebase=nAChR^#gephebase-summary-title)	Gephebase Gene	GP00002553	GephelD
	Entry Status	Courtier	Main curator
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		
Myzus persicae	Trait State in Taxon B		
Myzus persicae - resistant	Ancestral State		
Taxon A	Taxonomic Status		
Intraspecific (https://www.gephebase.org/search-criteria/?and+Taxonomic Status=Intraspecific^#gephebase-summary-title)			
Taxon A	Latin Name	Taxon B	Latin Name
Myzus persicae (https://www.gephebase.org/search-criteria/?and+Taxon+and+Synonyms=Myzus+persicae^#gephebase-summary-title)	Myzus persicae (https://www.gephebase.org/search-criteria/?and+Taxon+and+Synonyms=Myzus+persicae^#gephebase-summary-title)	Myzus persicae (https://www.gephebase.org/search-criteria/?and+Taxon+and+Synonyms=Myzus+persicae^#gephebase-summary-title)	Myzus persicae (https://www.gephebase.org/search-criteria/?and+Taxon+and+Synonyms=Myzus+persicae^#gephebase-summary-title)
green peach aphid	Common Name	green peach aphid	Common Name
Myzus (Nectarosiphon) persicae; green peach aphid; peach-potato aphid; Myzus persicae (Sulzer, 1776); Myzus persiceae	Synonyms	Myzus (Nectarosiphon) persicae; green peach aphid; peach-potato aphid; Myzus persicae (Sulzer, 1776); Myzus persiceae	Synonyms
species	Rank	species	Rank
cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Protostomia; Ecdysozoa; Panarthropoda; Arthropoda; Mandibulata; Pancrustacea; Hexapoda; Insecta; Dicondylia; Pterygota; Neoptera; Paraneoptera; Hemiptera; Sternorrhyncha; Aphidomorpha; Aphidoidea; Aphididae; Aphidinae; Macrosiphini; Myzus	Lineage	cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Protostomia; Ecdysozoa; Panarthropoda; Arthropoda; Mandibulata; Pancrustacea; Hexapoda; Insecta; Dicondylia; Pterygota; Neoptera; Paraneoptera; Hemiptera; Sternorrhyncha; Aphidomorpha; Aphidoidea; Aphididae; Aphidinae; Macrosiphini; Myzus	Lineage
Myzus () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=13163)	Parent	Myzus () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=13163)	Parent
13164 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=13164)	NCBI Taxonomy ID	13164 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=13164)	NCBI Taxonomy ID
No	is Taxon A an Infraspecies?	No	is Taxon B an Infraspecies?

GENOTYPIC CHANGE

Generic Gene Name			
nAChRbeta1	Synonyms	P04755 (http://www.uniprot.org/uniprot/P04755)	UniProtKB Drosophila melanogaster
AChR; AchR64B; AChR64B; Acr64B; AcrD; ard; Ard; ARD; beta 64B; beta1 nAChR; CG11348; CG11348-PA; CG12606; Dbeta1; Dmel\CG11348; nAChR; nAChR-beta64B; nAcR64B; nAcRbeta-64B	String	0	GenebankID or UniProtKB
7227.FBpp0073155 (http://string-db.org/newstring_cgi/show_network_section.pl?identifier=7227.FBpp0073155)	Sequence Similarities		
Belongs to the ligand-gated ion channel (TC 1.A.9) family. Acetylcholine receptor (TC 1.A.9.1) subfamily.	GO - Molecular Function		
GO:0004888 : transmembrane signaling receptor activity (https://www.ebi.ac.uk/QuickGO/term/GO:0004888)			
GO:0022848 : acetylcholine-gated cation-selective channel activity			

(<https://www.ebi.ac.uk/QuickGO/term/GO:0022848>)
 GO:1904315 : transmitter-gated ion channel activity involved in regulation of postsynaptic membrane potential (<https://www.ebi.ac.uk/QuickGO/term/GO:1904315>)
 GO:0005231 : excitatory extracellular ligand-gated ion channel activity (<https://www.ebi.ac.uk/QuickGO/term/GO:0005231>)
 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:0007271 : synaptic transmission, cholinergic (<https://www.ebi.ac.uk/QuickGO/term/GO:0007271>)
 GO:0034220 : ion transmembrane transport (<https://www.ebi.ac.uk/QuickGO/term/GO:0034220>)
 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 - Cellular Component

GO:0005887 : integral component of plasma membrane (<https://www.ebi.ac.uk/QuickGO/term/GO:0005887>)
 GO:0043005 : neuron projection (<https://www.ebi.ac.uk/QuickGO/term/GO:0043005>)
 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:0070161 : anchoring junction (<https://www.ebi.ac.uk/QuickGO/term/GO:0070161>)

Presumptive Null

No (<https://www.gephebase.org/search-criteria/?and+Presumptive+Null=%22No%22#gephebase-summary-title>)

Molecular Type

Coding (<https://www.gephebase.org/search-criteria/?and+Molecular+Type=%22Coding%22#gephebase-summary-title>)

Aberration Type

SNP (<https://www.gephebase.org/search-criteria/?and+Aberration+Type=%22SNP%22#gephebase-summary-title>)

SNP Coding Change

Nonsynonymous

Molecular Details of the Mutation

R81T in the loop D region of the nAChR $\beta 2$ subunit of the resistant clone

Experimental Evidence

Candidate Gene (<https://www.gephebase.org/search-criteria/?and+Experimental+Evidence=%22Candidate+Gene%22#gephebase-summary-title>)

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

Mutation of a nicotinic acetylcholine receptor $\beta 2$ subunit is associated with resistance to neonicotinoid insecticides in the aphid *Myzus persicae*. (2011) (<https://pubmed.ncbi.nlm.nih.gov/21627790/>)

Main Reference

Bass C; Puinean AM; Andrews M; Cutler P; Daniels M; Elias J; Paul VL; Crossthwaite AJ; Denholm I; Field LM; Foster SP; Lind R; Williamson MS; Slater R

Authors

Myzus persicae is a globally important aphid pest with a history of developing resistance to insecticides. Unusually, neonicotinoids have remained highly effective as control agents despite nearly two decades of steadily increasing use. In this study, a clone of *M. persicae* collected from southern France was found, for the first time, to exhibit sufficiently strong resistance to result in loss of the field effectiveness of neonicotinoids.

Bioassays, metabolism and gene expression studies implied the presence of two resistance mechanisms in the resistant clone, one based on enhanced detoxification by cytochrome P450 monooxygenases, and another unaffected by a synergist that inhibits detoxifying enzymes. Binding of radiolabeled imidacloprid (a neonicotinoid) to whole body membrane preparations showed that the high affinity [3 H]-imidacloprid binding site present in susceptible *M. persicae* is lost in the resistant clone and the remaining lower affinity site is altered compared to susceptible clones. This confers a significant overall reduction in binding affinity to the neonicotinoid target: the nicotinic acetylcholine receptor (nAChR). Comparison of the nucleotide sequence of six nAChR subunit ($M\beta 1-5$ and $M\beta 2-1$) genes from resistant and susceptible aphid clones revealed a single point mutation in the loop D region of the nAChR $\beta 2$ subunit of the resistant clone, causing an arginine to threonine substitution (R81T).

Previous studies have shown that the amino acid at this position within loop D is a key determinant of neonicotinoid binding to nAChRs and this amino acid change confers a vertebrate-like character to the insect nAChR receptor and results in reduced sensitivity to neonicotinoids. The discovery of the mutation at this position and its association with the reduced affinity of the nAChR for imidacloprid is the first example of field-evolved target-site resistance to neonicotinoid insecticides and also provides further validation of existing models of neonicotinoid binding and selectivity for insect nAChRs.

Additional References

Genotype to phenotype, the molecular and physiological dimensions of resistance in arthropods. (2015) (<https://pubmed.ncbi.nlm.nih.gov/26047113/>)

Global patterns in genomic diversity underpinning the evolution of insecticide resistance in the aphid crop pest *Myzus persicae*. (2021) (<https://pubmed.ncbi.nlm.nih.gov/34234279/>)

8 (acetyl-CoA carboxylase (ACC), Acetylcholinesterase (Ace-1), CYP6CY3, CYP6CY3-CYP6CY4, esterase E4, esterase FE4, para (kdr), resistance to dieldrin)
([https://www.gephebase.org/search-criteria?/or+Taxon ID=%2713164%27/and+Trait=Xenobiotic resistance/and+groupHaplotypes=true#gephebase-summary-title](https://www.gephebase.org/search-criteria?/or+Taxon%20ID=%2713164%27/and+Trait=Xenobiotic%20resistance/and+groupHaplotypes=true#gephebase-summary-title))

Related Haplotypes

1 ([https://www.gephebase.org/search-criteria?/or+Gene Gephebase=%27nAChR%27/and+Taxon ID=%2713164%27/and+Trait=Xenobiotic resistance/and+groupHaplotypes=true#gephebase-summary-title](https://www.gephebase.org/search-criteria?/or+Gene%20Gephebase=%27nAChR%27/and+Taxon%20ID=%2713164%27/and+Trait=Xenobiotic%20resistance/and+groupHaplotypes=true#gephebase-summary-title))

EXTERNAL LINKS

COMMENTS

@Epistasis The R81T mutation is only observed in clones displaying also the CYP6CY3 amplification.