

GEPHE SUMMARY

nAChR (https://www.gephebase.org/search-criteria?/and+GeneGephebase=~nAChR^#gephebase-summary-title)	Gephebase Gene	GP00002553	GepheID
Published	Entry Status	Courtier	Main curator

PHENOTYPIC CHANGE

Physiology (https://www.gephebase.org/search-criteria?/and+TraitCategory=~Physiology^#gephebase-summary-title)	Trait Category		
Xenobiotic resistance (insecticide) (https://www.gephebase.org/search-criteria?/and+Trait=~Xenobiotic resistance (insecticide)^#gephebase-summary-title)	Trait		
Myzus persicae	Trait State in Taxon A		
Myzus persicae - resistant	Trait State in Taxon B		
Taxon A	Ancestral State		
Intraspecific (https://www.gephebase.org/search-criteria?/and+TaxonomicStatus=~Intraspecific^#gephebase-summary-title)	Taxonomic Status		
	Taxon A		Taxon B
Myzus persicae (https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=~Myzus persicae^#gephebase-summary-title)	Latin Name	Myzus persicae (https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=~Myzus persicae^#gephebase-summary-title)	Latin Name
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 Infrappecies?	No	is Taxon B an Infrappecies?

GENOTYPIC CHANGE

nAChRbeta1	Generic Gene Name	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	Synonyms	()	GenebankID or UniProtKB
7227.FBpp0073155 (http://string-db.org/newstring.cgi/show_network_section.pl?identifier=7227.FBpp0073155)	String		
Belongs to the ligand-gated ion channel (TC 1.A.9) family. Acetylcholine receptor (TC 1.A.9.1) subfamily.	Sequence Similarities		
GO:0004888 : transmembrane signaling receptor activity (https://www.ebi.ac.uk/QuickGO/term/GO:0004888)	GO - Molecular Function		
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>)

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

Presumptive Null

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

Molecular Type

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

Aberration Type

Nonsynonymous

SNP Coding Change

R81T in the loop D region of the nAChR \hat{I}^2 subunit of the resistant clone

Molecular Details of the Mutation

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

Experimental Evidence

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

Main Reference

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

Authors

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

Abstract

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 [³H]-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 (Mpl^{±1-5} and Mpl^{±1}) genes from resistant and susceptible aphid clones revealed a single point mutation in the loop D region of the nAChR \hat{I}^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=~13164~/and+Trait=Xenobiotic resistance/and+groupHaplotypes=true#gephebase-summary-title>)

Related Haplotypes

1 (<https://www.gephebase.org/search-criteria?/or+Gene Gephebase=~nAChR~/and+Taxon ID=~13164~/or+Gene Gephebase=~nAChR~/and+Taxon ID=~13164~/#gephebase-summary-title>)

EXTERNAL LINKS

COMMENTS

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