

GEPHE SUMMARY

CYP6CY3 (https://www.gephebase.org/search-criteria?/and+Gene+Gephebase=CYP6CY3#gephebase-summary-title)	Gephebase Gene	GP00001474	GepheID
Published	Entry Status	Prigent	Main curator

PHENOTYPIC CHANGE

Physiology (https://www.gephebase.org/search-criteria?/and+Trait+Category=Physiology#gephebase-summary-title)	Trait Category		
Xenobiotic resistance (insecticide; neonicotinoid; host plant) (https://www.gephebase.org/search-criteria?/and+Trait=Xenobiotic+resistance+(insecticide;+neonicotinoid;+host+plant)#gephebase-summary-title)	Trait		
Peach-potato aphid 4106A does not survive for 144h on a diet containing 30ppm nicotine ; tobacco aphid JR with 100% mortality at 144h on a diet containing 320ppm nicotine	Trait State in Taxon A		
tobacco aphid 5410R with 7% mortality at 144h on a diet containing 320ppm nicotine ; tobacco aphid 5191A survive for 144h on a diet containing 30ppm nicotine	Trait State in Taxon B		
	Ancestral State		
	Taxon A		
Intraspecific (https://www.gephebase.org/search-criteria?/and+Taxonomic+Status=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
Yes	is Taxon A an Intraspecies?	Yes	is Taxon B an Intraspecies?
Peach-potato aphid 4106A does not survive for 144h on a diet containing 30ppm nicotine ; tobacco aphid JR with 100% mortality at 144h on a diet containing 320ppm nicotine	Taxon A Description	tobacco aphid 5410R with 7% mortality at 144h on a diet containing 320ppm nicotine ; tobacco aphid 5191A survive for 144h on a diet containing 30ppm nicotine	Taxon B Description

GENOTYPIC CHANGE

CYP6CY3	Generic Gene Name	V5SQ25 (http://www.uniprot.org/uniprot/V5SQ25)	UniProtKB Myzus persicae
-	Synonyms		GenebankID or UniProtKB
-	String		
	Sequence Similarities		
Belongs to the cytochrome P450 family.			
	GO - Molecular Function		
GO:0020037 : heme binding (https://www.ebi.ac.uk/QuickGO/term/GO:0020037)			
GO:0005506 : iron ion binding (https://www.ebi.ac.uk/QuickGO/term/GO:0005506)			

GO:0004497 : monooxygenase activity
(<https://www.ebi.ac.uk/QuickGO/term/GO:0004497>)

GO:0016705 : oxidoreductase activity, acting on paired donors, with incorporation or reduction of molecular oxygen (<https://www.ebi.ac.uk/QuickGO/term/GO:0016705>)

GO - Biological Process

-

GO - Cellular Component

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

Presumptive Null

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

Molecular Type

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

Aberration Type

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

Insertion Size

10-99 bp

Molecular Details of the Mutation

Expansion of a AC dinucleotide microsatellite (from 15 to 48 repeat units) in the promoter 198 bp upstream of the start codon that enhances gene expression

Experimental Evidence

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

Main Reference

Gene amplification and microsatellite polymorphism underlie a recent insect host shift. (2013) (<https://pubmed.ncbi.nlm.nih.gov/24218582>)

Authors

Bass C; Zimmer CT; Riveron JM; Wilding CS; Wondji CS; Kausmann M; Field LM; Williamson MS; Nauen R

Abstract

Host plant shifts of herbivorous insects may be a first step toward sympatric speciation and can create new pests of agriculturally important crops; however, the molecular mechanisms that mediate this process are poorly understood. Certain races of the polyphagous aphid *Myzus persicae* have recently adapted to feed on tobacco (*Myzus persicae nicotianae*) and show a reduced sensitivity to the plant alkaloid nicotine and cross-resistance to neonicotinoids a class of synthetic insecticides widely used for control. Here we show constitutive overexpression of a cytochrome P450 (CYP6CY3) allows tobacco-adapted races of *M. persicae* to efficiently detoxify nicotine and has preadapted them to resist neonicotinoid insecticides. CYP6CY3, is highly overexpressed in *M. persicae nicotianae* clones from three continents compared with *M. persicae s.s.* and expression level is significantly correlated with tolerance to nicotine. CYP6CY3 is highly efficient (compared with the primary human nicotine-metabolizing P450) at metabolizing nicotine and neonicotinoids to less toxic metabolites in vitro and generation of transgenic *Drosophila* expressing CYP6CY3 demonstrate that it confers resistance to both compounds in vivo. Overexpression of CYP6CY3 results from the expansion of a dinucleotide microsatellite in the promoter region and a recent gene amplification, with some aphid clones carrying up to 100 copies. We conclude that the mutations leading to overexpression of CYP6CY3 were a prerequisite for the host shift of *M. persicae* to tobacco and that gene amplification and microsatellite polymorphism are evolutionary drivers in insect host adaptation.

Additional References

Gene amplification and microsatellite polymorphism underlie a recent insect host shift. (2013) (<https://pubmed.ncbi.nlm.nih.gov/24218582>)

RELATED GEPHE

Related Genes

8 (acetyl-CoA carboxylase (ACC), Acetylcholinesterase (Ace-1), CYP6CY3-CYP6CY4, esterase E4, esterase FE4, nAChR, 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

No matches found.

EXTERNAL LINKS

COMMENTS

For four of the *M. persicae nicotianae* clones all amplified copies of CYP6CY3 appear to share the microsatellite expansion suggests that this mutation predates the gene amplification event ; an other A>G SNP 138 bp upstream of the start codon is also observed but it is experimentally shown to not be involved