

GEPHE SUMMARY

	Gephebase Gene		GepheID
Acetylcholinesterase (Ace-1) (https://www.gephebase.org/search-criteria?/and+Gene)		GP00000036	
Gephebase="Acetylcholinesterase (Ace-1)"#gephebase-summary-title)			Main curator
Published	Entry Status	Martin	

PHENOTYPIC CHANGE

	Trait Category
Physiology (https://www.gephebase.org/search-criteria?/and+Trait)	
Category="Physiology"#gephebase-summary-title)	Trait
Xenobiotic resistance (insecticide) (<a #gephebase-summary-title"="" href="https://www.gephebase.org/search-criteria?/and+Trait=Xenobiotic+resistance+(insecticide)">https://www.gephebase.org/search-criteria?/and+Trait=Xenobiotic+resistance+(insecticide)"#gephebase-summary-title)	
	Trait State in Taxon A
Aphis gossypii	
	Trait State in Taxon B
Aphis gossypii	
	Ancestral State
Data not curated	
	Taxonomic Status
Intraspecific (https://www.gephebase.org/search-criteria?/and+Taxonomic)	
Status="Intraspecific"#gephebase-summary-title)	

Taxon A	Latin Name	Taxon B	Latin Name
Aphis gossypii		Aphis gossypii	
(<a #gephebase-summary-title"="" href="https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=Aphis+gossypii">https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=Aphis+gossypii"#gephebase-summary-title)		(<a #gephebase-summary-title"="" href="https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=Aphis+gossypii">https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=Aphis+gossypii"#gephebase-summary-title)	
	Common Name		Common Name
cotton aphid		cotton aphid	
	Synonyms		Synonyms
cotton aphid; melon aphid; Aphis gossypii Glover, 1877; Aphis gossypii		cotton aphid; melon aphid; Aphis gossypii Glover, 1877; Aphis gossypii	
	Rank		Rank
species		species	
	Lineage		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; Aphidini; Aphis; Aphis		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; Aphidini; Aphis; Aphis	
	Parent		Parent
Aphis () - (Rank: subgenus)		Aphis () - (Rank: subgenus)	
(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=464929)		(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=464929)	
	NCBI Taxonomy ID		NCBI Taxonomy ID
80765		80765	
(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=80765)		(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=80765)	
	is Taxon A an Intraspecies?		is Taxon B an Intraspecies?
No		No	

GENOTYPIC CHANGE

	Generic Gene Name		UniProtKB Drosophila melanogaster
Ace		P07140 (http://www.uniprot.org/uniprot/P07140)	
	Synonyms		GenebankID or UniProtKB
AcChE; ace; ACE; ace-2; ache; AchE; AchE; CG17907; CHE; dAcChE; dmAcChE; DmAcChE; Dmel\CG17907; Dm_ace; FBgn0000024; l(3)26; l(3)87Ed		ALE67001 (https://www.ncbi.nlm.nih.gov/nuccore/ALE67001)	
	String		
7227.FBpp0289713			
(http://string-db.org/newstring.cgi/show_network_section.pl?identifier=7227.FBpp0289713)			
	Sequence Similarities		
Belongs to the type-B carboxylesterase/lipase family.			
	GO - Molecular Function		
GO:0042803 : protein homodimerization activity			
(https://www.ebi.ac.uk/QuickGO/term/GO:0042803)			
GO:0003990 : acetylcholinesterase activity			
(https://www.ebi.ac.uk/QuickGO/term/GO:0003990)			
GO:0004104 : cholinesterase activity (https://www.ebi.ac.uk/QuickGO/term/GO:0004104)			
GO:0043199 : sulfate binding (https://www.ebi.ac.uk/QuickGO/term/GO:0043199)			

- GO:0006581 : acetylcholine catabolic process
(<https://www.ebi.ac.uk/QuickGO/term/GO:0006581>)
- GO:0001507 : acetylcholine catabolic process in synaptic cleft
(<https://www.ebi.ac.uk/QuickGO/term/GO:0001507>)
- GO:0007268 : chemical synaptic transmission
(<https://www.ebi.ac.uk/QuickGO/term/GO:0007268>)
- GO:0042426 : choline catabolic process
(<https://www.ebi.ac.uk/QuickGO/term/GO:0042426>)
- GO:0042331 : phototaxis (<https://www.ebi.ac.uk/QuickGO/term/GO:0042331>)

GO - Cellular Component

- GO:0005886 : plasma membrane (<https://www.ebi.ac.uk/QuickGO/term/GO:0005886>)
- GO:0005737 : cytoplasm (<https://www.ebi.ac.uk/QuickGO/term/GO:0005737>)
- GO:0031225 : anchored component of membrane
(<https://www.ebi.ac.uk/QuickGO/term/GO:0031225>)
- GO:0030054 : cell junction (<https://www.ebi.ac.uk/QuickGO/term/GO:0030054>)
- GO:0043083 : synaptic cleft (<https://www.ebi.ac.uk/QuickGO/term/GO:0043083>)

Mutation #1

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

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

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

1-10 kb Insertion Size

Duplications; A302S and S431F = S331F Molecular Details of the Mutation

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

Extensive Ace2 duplication and multiple mutations on Ace1 and Ace2 are related with high level of organophosphates resistance in Aphis gossypii. (2014) Main Reference
(<https://pubmed.ncbi.nlm.nih.gov/22489048>)

Shang Q; Pan Y; Fang K; Xi J; Wong A; Brennan JA; Cao C Authors

Aphis gossypii (Glover) has been found to possess multiple mutations in the acetylcholinesterase (AChE) gene (Ace) that might involve target site insensitivity. In vitro functional expression of AChEs reveals that the resistant Ace1 (Ace1R) and Ace2 (Ace2R) were significantly less inhibited by eserine, omethoate, and malaoxon than the susceptible Ace1 (Ace1S) and Ace2 (Ace2S). Furthermore, in both the mutant and susceptible AChEs, Ace2 was significantly less sensitive to eserine, omethoate, and malaoxon than Ace1. These results suggested that both the mutant Ace1 and Ace2 were responsible for omethoate resistance, while the mutant Ace2 played a major role in insecticide resistance. The DNA copy number and transcription level of Ace2 were 1.52- and 1.88-fold higher in the ORR strain than in the OSS strain. Furthermore, the DNA copy number and transcription level of Ace2 were significantly higher than that of Ace1 in either OSS or ORR strains, demonstrating the involvement of Ace2 gene duplication in resistance. Thus, the authors conclude that omethoate resistance in cotton aphids appears to have evolved through a combination of multiple mutations and extensive Ace2R gene duplication. Abstract

Copyright © 2012 Wiley Periodicals, Inc.

Identification of mutations conferring insecticide-insensitive AChE in the cotton-melon aphid, Aphis gossypii Glover. (2004) (<https://pubmed.ncbi.nlm.nih.gov/15373812>)
Biochemical evidence that an S431F mutation in acetylcholinesterase-1 of Aphis gossypii mediates resistance to pirimicarb and omethoate. (2004) (<https://pubmed.ncbi.nlm.nih.gov/15532677>)
Two amino acid substitutions in acetylcholinesterase associated with pirimicarb and organophosphorous insecticide resistance in the cotton aphid, Aphis gossypii Glover (Homoptera: Aphididae). (2004) (<https://pubmed.ncbi.nlm.nih.gov/15373811>) Additional References

Extensive Ace2 duplication and multiple mutations on Ace1 and Ace2 are related with high level of organophosphates resistance in Aphis gossypii. (2014) Main Reference

Mutation #2

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

Duplications; A302S and S431F Molecular Details of the Mutation

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

Extensive Ace2 duplication and multiple mutations on Ace1 and Ace2 are related with high level of organophosphates resistance in Aphis gossypii. (2014) Main Reference

	Taxon A	Taxon B	Position
Codon	-	-	-
Amino-acid	Ala	Ser	302

Extensive Ace2 duplication and multiple mutations on Ace1 and Ace2 are related with high level of organophosphates resistance in Aphis gossypii. (2014) Main Reference

(<https://pubmed.ncbi.nlm.nih.gov/22489048>)

Authors

Shang Q; Pan Y; Fang K; Xi J; Wong A; Brennan JA; Cao C

Abstract

Aphis gossypii (Glover) has been found to possess multiple mutations in the acetylcholinesterase (AChE) gene (*Ace*) that might involve target site insensitivity. In vitro functional expression of AChEs reveals that the resistant *Ace1* (*Ace1R*) and *Ace2* (*Ace2R*) were significantly less inhibited by eserine, omethoate, and malaoxon than the susceptible *Ace1* (*Ace1S*) and *Ace2* (*Ace2S*). Furthermore, in both the mutant and susceptible AChEs, *Ace2* was significantly less sensitive to eserine, omethoate, and malaoxon than *Ace1*. These results suggested that both the mutant *Ace1* and *Ace2* were responsible for omethoate resistance, while the mutant *Ace2* played a major role in insecticide resistance. The DNA copy number and transcription level of *Ace2* were 1.52- and 1.88-fold higher in the ORR strain than in the OSS strain. Furthermore, the DNA copy number and transcription level of *Ace2* were significantly higher than that of *Ace1* in either OSS or ORR strains, demonstrating the involvement of *Ace2* gene duplication in resistance. Thus, the authors conclude that omethoate resistance in cotton aphids appears to have evolved through a combination of multiple mutations and extensive *Ace2R* gene duplication.

Copyright © 2012 Wiley Periodicals, Inc.

Additional References

Identification of mutations conferring insecticide-insensitive AChE in the cotton-melon aphid, *Aphis gossypii* Glover. (2004) (<https://pubmed.ncbi.nlm.nih.gov/15373812>)
Insecticide resistance traits differ among and within host races in *Aphis gossypii*. (2010) (<https://pubmed.ncbi.nlm.nih.gov/19908228>)

Mutation #3

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

Duplications; A302S and S431F

Experimental Evidence

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

	Taxon A	Taxon B	Position
Codon	-	-	-
Amino-acid	Ser	Phe	431

Main Reference

Extensive *Ace2* duplication and multiple mutations on *Ace1* and *Ace2* are related with high level of organophosphates resistance in *Aphis gossypii*. (2014) (<https://pubmed.ncbi.nlm.nih.gov/22489048>)

Authors

Shang Q; Pan Y; Fang K; Xi J; Wong A; Brennan JA; Cao C

Abstract

Aphis gossypii (Glover) has been found to possess multiple mutations in the acetylcholinesterase (AChE) gene (*Ace*) that might involve target site insensitivity. In vitro functional expression of AChEs reveals that the resistant *Ace1* (*Ace1R*) and *Ace2* (*Ace2R*) were significantly less inhibited by eserine, omethoate, and malaoxon than the susceptible *Ace1* (*Ace1S*) and *Ace2* (*Ace2S*). Furthermore, in both the mutant and susceptible AChEs, *Ace2* was significantly less sensitive to eserine, omethoate, and malaoxon than *Ace1*. These results suggested that both the mutant *Ace1* and *Ace2* were responsible for omethoate resistance, while the mutant *Ace2* played a major role in insecticide resistance. The DNA copy number and transcription level of *Ace2* were 1.52- and 1.88-fold higher in the ORR strain than in the OSS strain. Furthermore, the DNA copy number and transcription level of *Ace2* were significantly higher than that of *Ace1* in either OSS or ORR strains, demonstrating the involvement of *Ace2* gene duplication in resistance. Thus, the authors conclude that omethoate resistance in cotton aphids appears to have evolved through a combination of multiple mutations and extensive *Ace2R* gene duplication.

Copyright © 2012 Wiley Periodicals, Inc.

Additional References

Identification of mutations conferring insecticide-insensitive AChE in the cotton-melon aphid, *Aphis gossypii* Glover. (2004) (<https://pubmed.ncbi.nlm.nih.gov/15373812>)
Insecticide resistance traits differ among and within host races in *Aphis gossypii*. (2010) (<https://pubmed.ncbi.nlm.nih.gov/19908228>)

RELATED GEPHE

Related Genes

3 (Acetylcholinesterase (*Ace-2*), nAChR, para (*kdr*)) (<https://www.gephebase.org/search-criteria?/or+Taxon ID=^80765^/and+Trait=Xenobiotic resistance/and+groupHaplotypes=true#gephebase-summary-title>)

Related Haplotypes

1 ([https://www.gephebase.org/search-criteria?/or+Gene Gephebase=^Acetylcholinesterase \(Ace-1\)^/and+Taxon ID=^80765^/or+Gene Gephebase=^Acetylcholinesterase \(Ace-1\)^/and+Taxon ID=^80765^#gephebase-summary-title](https://www.gephebase.org/search-criteria?/or+Gene Gephebase=^Acetylcholinesterase (Ace-1)^/and+Taxon ID=^80765^/or+Gene Gephebase=^Acetylcholinesterase (Ace-1)^/and+Taxon ID=^80765^#gephebase-summary-title))

EXTERNAL LINKS

COMMENTS

@SeveralMutationsWithEffect