

GEPHE SUMMARY

	Gephebase Gene		GepheID
Chitin synthase 1 (CHS1) (https://www.gephebase.org/search-criteria?/and+Gene Gephebase="Chitin synthase 1 (CHS1)"#gephebase-summary-title)		GP00001600	
	Entry Status	Prigent	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 ; benzoylurea) (<a (insecticide="" ;="" benzoylurea)"#gephebase-summary-title"="" href="https://www.gephebase.org/search-criteria?/and+Trait=" resistance="" xenobiotic="">https://www.gephebase.org/search-criteria?/and+Trait="Xenobiotic resistance (insecticide ; benzoylurea)"#gephebase-summary-title)			
	Trait State in Taxon A		
Plutella xylostella BCS-S and Japan reference strains susceptible			
	Trait State in Taxon B		
Plutella xylostella Sudlon-Tfm strain sampled in a Philippine cabbage field selected with triflumuron under laboratory conditions resistant to diverse BPU and also etoxazole (>178-fold)			
	Ancestral State		
Unknown			
	Taxonomic Status		
Intraspecific (https://www.gephebase.org/search-criteria?/and+Taxonomic Status="Intraspecific"#gephebase-summary-title)			
	Taxon A		Taxon B
	Latin Name		Latin Name
Plutella xylostella (https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms="Plutella xylostella"#gephebase-summary-title)		Plutella xylostella (https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms="Plutella xylostella"#gephebase-summary-title)	
	Common Name		Common Name
diamondback moth		diamondback moth	
	Synonyms		Synonyms
diamondback moth; cabbage moth; Plutella xylostella (Linnaeus, 1758); Putella xylostella		diamondback moth; cabbage moth; Plutella xylostella (Linnaeus, 1758); Putella xylostella	
	Rank		Rank
species		species	
	Lineage		Lineage
cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Protostomia; Ecdysozoa; Panarthropoda; Arthropoda; Mandibulata; Pancrustacea; Hexapoda; Insecta; Dicondylia; Pterygota; Neoptera; Holometabola; Amphiesmenoptera; Lepidoptera; Glossata; Neolepidoptera; Heteroneura; Ditrysia; Yponomeutoidea; Plutellidae; Plutella		cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Protostomia; Ecdysozoa; Panarthropoda; Arthropoda; Mandibulata; Pancrustacea; Hexapoda; Insecta; Dicondylia; Pterygota; Neoptera; Holometabola; Amphiesmenoptera; Lepidoptera; Glossata; Neolepidoptera; Heteroneura; Ditrysia; Yponomeutoidea; Plutellidae; Plutella	
	Parent		Parent
Plutella () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 51654)		Plutella () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 51654)	
	NCBI Taxonomy ID		NCBI Taxonomy ID
51655 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 51655)		51655 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 51655)	
	is Taxon A an Intraspecies?		is Taxon B an Intraspecies?
Yes		Yes	
	Taxon A Description		Taxon B Description
Plutella xylostella BCS-S and Japan reference strains susceptible		Plutella xylostella Sudlon-Tfm strain sampled in a Philippine cabbage field selected with triflumuron under laboratory conditions resistant to diverse BPU and also etoxazole (>178-fold)	

GENOTYPIC CHANGE

	Generic Gene Name		UniProtKB Plutella xylostella
CHS1		A3KCN0 (http://www.uniprot.org/uniprot/A3KCN0)	
	Synonyms		GenebankID or UniProtKB
CHS1; PxCHS1B		KX420690 (https://www.ncbi.nlm.nih.gov/nuccore/KX420690)	
	String		
-			
	Sequence Similarities		
-			
	GO - Molecular Function		
GO:0016758 : transferase activity, transferring hexosyl groups (https://www.ebi.ac.uk/QuickGO/term/GO:0016758)			

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

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

T>G p.I1042M (I1056 in D. melanogaster) located in the C-terminal transmembrane domain

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	-	-	-

Main Reference

Resistance mutation conserved between insects and mites unravels the benzoylurea insecticide mode of action on chitin biosynthesis. (2016) (<https://pubmed.ncbi.nlm.nih.gov/27930336>)

Authors

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Abstract

Despite the major role of chitin biosynthesis inhibitors such as benzoylureas (BPUs) in the control of pests in agricultural and public health for almost four decades, their molecular mode of action (MoA) has in most cases remained elusive. BPUs interfere with chitin biosynthesis and were thought to interact with sulfonylurea receptors that mediate chitin vesicle transport. Here, we uncover a mutation (I1042M) in the chitin synthase 1 (CHS1) gene of BPU-resistant *Plutella xylostella* at the same position as the I1017F mutation reported in spider mites that confers etoxazole resistance. Using a genome-editing CRISPR/Cas9 approach coupled with homology-directed repair (HDR) in *Drosophila melanogaster*, we introduced both substitutions (I1056M/F) in the corresponding fly CHS1 gene (kkv). Homozygous lines bearing either of these mutations were highly resistant to etoxazole and all tested BPUs, as well as buprofezin-an important hemipteran chitin biosynthesis inhibitor. This provides compelling evidence that BPUs, etoxazole, and buprofezin share in fact the same molecular MoA and directly interact with CHS. This finding has immediate effects on resistance management strategies of major agricultural pests but also on mosquito vectors of serious human diseases such as Dengue and Zika, as diflubenzuron, the standard BPU, is one of the few effective larvicides in use. The study elaborates on how genome editing can directly, rapidly, and convincingly elucidate the MoA of bioactive molecules, especially when target sites are complex and hard to reconstitute in vitro.

Additional References

RELATED GEPHE

Related Genes

10 (ABCC2, Acetylcholinesterase (Ace-1), CYP6BG1, FMO2, glutamate-gated chloride channel (GluCl), MAP4K4, nAChR, para (kdr), resistance to dieldrin, RYR)
(<https://www.gephebase.org/search-criteria?/or+Taxon ID=~51655~/and+Trait=Xenobiotic resistance/and+groupHaplotypes=true#gephebase-summary-title>)

Related Haplotypes

1 ([https://www.gephebase.org/search-criteria?/or+Gene Gephebase=~Chitin synthase 1 \(CHS1\)~/and+Taxon ID=~51655~/or+Gene Gephebase=~Chitin synthase 1 \(CHS1\)~/and+Taxon ID=~51655~#gephebase-summary-title](https://www.gephebase.org/search-criteria?/or+Gene Gephebase=~Chitin synthase 1 (CHS1)~/and+Taxon ID=~51655~/or+Gene Gephebase=~Chitin synthase 1 (CHS1)~/and+Taxon ID=~51655~#gephebase-summary-title))

EXTERNAL LINKS

COMMENTS

The mutation was present at low frequency (3%) in the Sudlon strain before selection and fixed in selected Sudlon-Tfm strain. It is homozygous in 7% of Japan strain and also present in field populations in China and India. Selected strain showed significant longer larval and pupal development time indicative of possible fitness costs associated with benzoylurea resistance. Transgenic flies with the same mutation is highly resistant to etoxazole and all tested benzoylureas as well as buprofezin