

CYP9A186 (https://www.gephebase.org/search-criteria?/and+GeneGephebase=~CYP9A186^#gephebase-summary-title)	Gephebase Gene	GP00002393	GepheID
Published	Entry Status	Courtier	Main curator

Trait Category		Trait		Trait State in Taxon A		Trait State in Taxon B		Ancestral State		Taxonomic Status	
Physiology (https://www.gephebase.org/search-criteria?/and+Trait+Category=~Physiology^#gephebase-summary-title)		Xenobiotic resistance (insecticide; avermectin; emamectin benzoate; abamectin) (https://www.gephebase.org/search-criteria?/and+Trait=~Xenobiotic resistance (insecticide; avermectin; emamectin benzoate; abamectin)^#gephebase-summary-title)		sensitive		resistant		Taxon A		Taxon B	
Intraspecific (https://www.gephebase.org/search-criteria?/and+Taxonomic+Status=~Intraspecific^#gephebase-summary-title)		Taxon A		Taxon B		Taxon A		Taxon B		Taxon A	
Spodoptera exigua (https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=~Spodoptera exigua^#gephebase-summary-title)		beet armyworm		beet armyworm; pigweed caterpillar; small mottled willow caterpillar; Spodoptera exigua (Hubner, 1808)		species		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; Obtectomera; Noctuoidea; Noctuidae; Amphipyrrinae; Spodoptera		Spodoptera () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=7106)	
NCBI Taxonomy ID		NCBI Taxonomy ID		is Taxon A an Intraspecies?		No		is Taxon B an Intraspecies?		No	

UniProtKB Spodoptera exigua	Generic Gene Name
A0A8E4AAI2 (http://www.uniprot.org/uniprot/A0A8E4AAI2)	CYP9A186
GenebankID or UniProtKB	Synonyms
Spodoptera exigua	-
	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

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

Heterologous expression and in vitro functional assays further confirm that a natural substitution (F116V) found in the substrate recognition site 1 (SRS1) of the CYP9A186 protein results in enhanced metabolism of EB and abamectin

Experimental Evidence

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

	Taxon A	Taxon B	Position
Codon	TTT	GTT	346
Amino-acid	Phe	Val	116

Main Reference

Genome mapping coupled with CRISPR gene editing reveals a P450 gene confers avermectin resistance in the beet armyworm. (2021) (<https://pubmed.ncbi.nlm.nih.gov/34252082>)

Authors

Zuo Y; Shi Y; Zhang F; Guan F; Zhang J; Feyereisen R; Fabrick JA; Yang Y; Wu Y

Abstract

The evolution of insecticide resistance represents a global constraint to agricultural production. Because of the extreme genetic diversity found in insects and the large numbers of genes involved in insecticide detoxification, better tools are needed to quickly identify and validate the involvement of putative resistance genes for improved monitoring, management, and countering of field-evolved insecticide resistance. The avermectins, emamectin benzoate (EB) and abamectin are relatively new pesticides with reduced environmental risk that target a wide number of insect pests, including the beet armyworm, *Spodoptera exigua*, an important global pest of many crops. Unfortunately, field resistance to avermectins recently evolved in the beet armyworm, threatening the sustainable use of this class of insecticides. Here, we report a high-quality chromosome-level assembly of the beet armyworm genome and use bulked segregant analysis (BSA) to identify the locus of avermectin resistance, which mapped on 15-16 Mbp of chromosome 17. Knockout of the CYP9A186 gene that maps within this region by CRISPR/Cas9 gene editing fully restored EB susceptibility, implicating this gene in avermectin resistance. Heterologous expression and in vitro functional assays further confirm that a natural substitution (F116V) found in the substrate recognition site 1 (SRS1) of the CYP9A186 protein results in enhanced metabolism of EB and abamectin. Hence, the combined approach of coupling gene editing with BSA allows for the rapid identification of metabolic resistance genes responsible for insecticide resistance, which is critical for effective monitoring and adaptive management of insecticide resistance.

Additional References

RELATED GEPHE

Related Genes

4 (ABCC2, CYP321A8, GSTe, RYR) (<https://www.gephebase.org/search-criteria?/or+Taxon ID=~7107^/and+Trait=Xenobiotic resistance/and+groupHaplotypes=true#gephebase-summary-title>)

Related Haplotypes

No matches found.

EXTERNAL LINKS

COMMENTS