GEPHE SUMMARY

Gephebase Gene

CYP337B3 (https://www.gephebase.org/search-criteria?/and+Gene Gephebase=^CYP337B3^#gephebase-summary-title)

GepheID

GP00002477

Entry Status

Published

Main curator

Courtier

PHENOTYPIC CHANGE

Trait Category

Physiology (https://www.gephebase.org/search-criteria?/and+Trait Category=^Physiology^#gephebase-summary-title)

Trait

Xenobiotic resistance (insecticide; pyrethroid) (https://www.gephebase.org/search-criteria?/and+Trait=^Xenobiotic resistance (insecticide; pyrethroid)^#gephebase-summary-title)

Trait State in Taxon A

Helicoverpa armigera - susceptible

Trait State in Taxon B

Helicoverpa armigera - resistant strain from Australia - allele CYP337B1v1

Ancestral State

Taxon A

Taxonomic Status

Intraspecific (https://www.gephebase.org/search-criteria?/and+Taxonomic Status=^Intraspecific^#gephebase-summary-title)

Taxon A

Latin Name

Helicoverpa armigera (https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=^Helicoverpa armigera^#gephebase-summary-title)

Common Name

cotton bollworm

Synonyms

Heliothis (Helicoverpa) armigera; Heliothis armigera; cotton bollworm; American bollworm; corn ear worm; scarce bordered straw; tobacco budworm; Helicoverpa armigera (Hubner, 1808)

Rank

species

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; Obtectomera; Noctuoidea; Noctuidae; Heliothinae; Helicoverpa

Parent

Helicoverpa () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 7112)

NCBI Taxonomy ID

29058 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 29058)

is Taxon A an Infraspecies?

No

Taxon B

Latin Name

Helicoverpa armigera (https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=^Helicoverpa armigera^#gephebase-summary-title)

Common Name

cotton bollworm

Synonyms

Heliothis (Helicoverpa) armigera; Heliothis armigera; cotton bollworm; American bollworm; corn ear worm; scarce bordered straw; tobacco budworm; Helicoverpa armigera (Hubner, 1808)

Rank

species

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; Obtectomera; Noctuoidea; Noctuidae; Heliothinae; Helicoverpa

Parent

Helicoverpa () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 7112)

NCBI Taxonomy ID

29058 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 29058)

is Taxon B an Infraspecies?

No

GENOTYPIC CHANGE

Generic Gene Name

CYP337B3

Synonyms

-

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

UniProtKB Helicoverpa armigera

A0A0H3V333 (http://www.uniprot.org/uniprot/A0A0H3V333)

GenebankID or UniProtKB Helicoverpa armigera

A0A0H3V333 (https://www.ncbi.nlm.nih.gov/nuccore/A0A0H3V333)

reduction of molecular oxygen (https://www.ebi.ac.uk/QuickGO/term/GO:0016705)

GO - Biological Process

-

GO - Cellular Component

GO:0005789 : endoplasmic reticulum membrane (https://www.ebi.ac.uk/QuickGO/term/GO:0005789)

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

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

Molecular Details of the Mutation

The unique P450 chimeric gene CYP337B3 arose from unequal crossing-over between two parental P450 genes CYP337B2 and CYP337B1 . CYP337B3 can metabolize pyrethroids in vitro. Neither parental enzyme has the ability to metabolize pyrethroids in vitro. The exclusive presence of CYP337B3 in resistant insects of this strain confers a 42-fold resistance to fenvalerate.

Experimental Evidence

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

Main Reference

Resistance of Australian Helicoverpa armigera to fenvalerate is due to the chimeric P450 enzyme CYP337B3. (2012) (https://pubmed.ncbi.nlm.nih.gov/22949643)

Authors

JouÃŸen N; Agnolet S; Lorenz S; SchÃ¶ne SE; Ellinger R; Schneider B; Heckel DG

Abstract

Worldwide, increasing numbers of insects have evolved resistance to a wide range of pesticides, which hampers their control in the field and, therefore, threatens agriculture. Members of the carboxylesterase and cytochrome P450 monooxygenase superfamilies are prominent candidates to confer metabolic resistance to pyrethroid insecticides. Both carboxylesterases and P450 enzymes have been shown to be involved in pyrethroid resistance in Australian Helicoverpa armigera, the noctuid species possessing by far the most reported resistance cases worldwide. However, specific enzymes responsible for pyrethroid resistance in field populations of this species have not yet been identified. Here, we show that the resistance toward fenvalerate in an Australian strain of H. armigera is due to a unique P450 enzyme, CYP337B3, which arose from unequal crossing-over between two parental P450 genes, resulting in a chimeric enzyme. CYP337B3 is capable of metabolizing fenvalerate into 4′-hydroxyfenvalerate, which exhibits no toxic effect on susceptible larvae; enzymes from the parental P450 genes showed no detectable fenvalerate metabolism. Furthermore, a polymorphic H. armigera strain could be bred into a susceptible line possessing the parental genes CYP337B1 and CYP337B2 and a resistant line possessing only CYP337B3. The exclusive presence of CYP337B3 in resistant insects of this strain confers a 42-fold resistance to fenvalerate. Thus, in addition to previously documented genetic mechanisms of resistance, recombination can also generate selectively advantageous variants, such as this chimeric P450 enzyme with an altered substrate specificity leading to a potent resistance mechanism.

Additional References

Multiple recombination events between two cytochrome P450 loci contribute to global pyrethroid resistance in Helicoverpa armigera. (2018) (https://pubmed.ncbi.nlm.nih.gov/30383872)

RELATED GEPHE

Related Genes

6 (ABCA2, Aminopeptidase N (APN), cadherin, Ha_BtR, para (kdr), tetraspanin) (https://www.gephebase.org/search-criteria?/or+Taxon ID=^29058^/and+Trait=Xenobiotic resistance/and+groupHaplotypes=true#gephebase-summary-title)

Related Haplotypes

7 (https://www.gephebase.org/search-criteria?/or+Gene Gephebase=^CYP337B3^/and+Taxon ID=^29058^/or+Gene Gephebase=^CYP337B3^/and+Taxon ID=^29058^#gephebase-summary-title)

EXTERNAL LINKS

COMMENTS

@Parallelism - Resistance to pyrethroids as a result from the formation of a chimeric P450 gene CYP337B3 has arisen multiple times during evolution of the cotton bollworm H. armigera.