

## GEPHE SUMMARY

<p>protoporphyrinogen oxidase (PPO2 = PPX2L) (<a href="https://www.gephebase.org/search-criteria?/and+Gene+Gephebase=^protoporphyrinogen+oxidase+(PPO2+PPX2L)^#gephebase-summary-title">https://www.gephebase.org/search-criteria?/and+Gene+Gephebase=^protoporphyrinogen+oxidase+(PPO2+PPX2L)^#gephebase-summary-title</a>)</p> <p>Published</p>	<p>Gephebase Gene</p> <p>GP00000929</p> <p>Martin</p> <p>Entry Status</p>	<p>GepheID</p> <p>Main curator</p>
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## PHENOTYPIC CHANGE

<p>Physiology (<a href="https://www.gephebase.org/search-criteria?/and+Trait+Category=^Physiology^#gephebase-summary-title">https://www.gephebase.org/search-criteria?/and+Trait+Category=^Physiology^#gephebase-summary-title</a>)</p> <p>Xenobiotic resistance (herbicides) (<a href="https://www.gephebase.org/search-criteria?/and+Trait=^Xenobiotic+resistance+(herbicides)^#gephebase-summary-title">https://www.gephebase.org/search-criteria?/and+Trait=^Xenobiotic+resistance+(herbicides)^#gephebase-summary-title</a>)</p> <p>Amaranthus tuberculatus - sensitive</p> <p>Amaranthus tuberculatus - resistant</p> <p>Taxon A</p> <p>Intraspecific (<a href="https://www.gephebase.org/search-criteria?/and+Taxonomic+Status=^Intraspecific^#gephebase-summary-title">https://www.gephebase.org/search-criteria?/and+Taxonomic+Status=^Intraspecific^#gephebase-summary-title</a>)</p>	<p>Trait Category</p> <p>Trait</p> <p>Trait State in Taxon A</p> <p>Trait State in Taxon B</p> <p>Ancestral State</p> <p>Taxonomic Status</p>	<p>Taxon B</p>
<p style="text-align: center;">Taxon A</p> <p>Amaranthus tuberculatus (<a href="https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=^Amaranthus+tuberculatus^#gephebase-summary-title">https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=^Amaranthus+tuberculatus^#gephebase-summary-title</a>)</p> <p style="text-align: center;">Common Name</p> <p>-</p> <p style="text-align: center;">Synonyms</p> <p>Amaranthus rudis; Amaranthus rudis J.D.Sauer; Amaranthus tuberculatus (Moq.) J.D.Sauer</p> <p style="text-align: center;">Rank</p> <p>species</p> <p style="text-align: center;">Lineage</p> <p>cellular organisms; Eukaryota; Viridiplantae; Streptophyta; Streptophytina; Embryophyta; Tracheophyta; Euphyllophyta; Spermatophyta; Magnoliophyta; Mesangiospermae; eudicotyledons; Gunneridae; Pentapetalae; Caryophyllales; Amaranthaceae; Amaranthus</p> <p style="text-align: center;">Parent</p> <p>Amaranthus () - (Rank: genus) (<a href="https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=3564">https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=3564</a>)</p> <p style="text-align: center;">NCBI Taxonomy ID</p> <p>277990 (<a href="https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=277990">https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=277990</a>)</p> <p style="text-align: center;">is Taxon A an Intraspecies?</p> <p>No</p>	<p>Latin Name</p> <p>Amaranthus tuberculatus (<a href="https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=^Amaranthus+tuberculatus^#gephebase-summary-title">https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=^Amaranthus+tuberculatus^#gephebase-summary-title</a>)</p> <p style="text-align: center;">Common Name</p> <p>-</p> <p style="text-align: center;">Synonyms</p> <p>Amaranthus rudis; Amaranthus rudis J.D.Sauer; Amaranthus tuberculatus (Moq.) J.D.Sauer</p> <p style="text-align: center;">Rank</p> <p>species</p> <p style="text-align: center;">Lineage</p> <p>cellular organisms; Eukaryota; Viridiplantae; Streptophyta; Streptophytina; Embryophyta; Tracheophyta; Euphyllophyta; Spermatophyta; Magnoliophyta; Mesangiospermae; eudicotyledons; Gunneridae; Pentapetalae; Caryophyllales; Amaranthaceae; Amaranthus</p> <p style="text-align: center;">Parent</p> <p>Amaranthus () - (Rank: genus) (<a href="https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=3564">https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=3564</a>)</p> <p style="text-align: center;">NCBI Taxonomy ID</p> <p>277990 (<a href="https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=277990">https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=277990</a>)</p> <p style="text-align: center;">is Taxon B an Intraspecies?</p> <p>No</p>	<p style="text-align: center;">Taxon B</p> <p>Amaranthus tuberculatus (<a href="https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=^Amaranthus+tuberculatus^#gephebase-summary-title">https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=^Amaranthus+tuberculatus^#gephebase-summary-title</a>)</p> <p style="text-align: center;">Common Name</p> <p>-</p> <p style="text-align: center;">Synonyms</p> <p>Amaranthus rudis; Amaranthus rudis J.D.Sauer; Amaranthus tuberculatus (Moq.) J.D.Sauer</p> <p style="text-align: center;">Rank</p> <p>species</p> <p style="text-align: center;">Lineage</p> <p>cellular organisms; Eukaryota; Viridiplantae; Streptophyta; Streptophytina; Embryophyta; Tracheophyta; Euphyllophyta; Spermatophyta; Magnoliophyta; Mesangiospermae; eudicotyledons; Gunneridae; Pentapetalae; Caryophyllales; Amaranthaceae; Amaranthus</p> <p style="text-align: center;">Parent</p> <p>Amaranthus () - (Rank: genus) (<a href="https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=3564">https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=3564</a>)</p> <p style="text-align: center;">NCBI Taxonomy ID</p> <p>277990 (<a href="https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=277990">https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=277990</a>)</p> <p style="text-align: center;">is Taxon B an Intraspecies?</p> <p>No</p>

## GENOTYPIC CHANGE

<p>PPX2L</p> <p>-</p> <p>-</p> <p>Belongs to the protoporphyrinogen oxidase family.</p> <p>GO - Molecular Function</p> <p>GO:0004729 : oxygen-dependent protoporphyrinogen oxidase activity (<a href="https://www.ebi.ac.uk/QuickGO/term/GO:0004729">https://www.ebi.ac.uk/QuickGO/term/GO:0004729</a>)</p> <p>GO - Biological Process</p> <p>GO:0006782 : protoporphyrinogen IX biosynthetic process (<a href="https://www.ebi.ac.uk/QuickGO/term/GO:0006782">https://www.ebi.ac.uk/QuickGO/term/GO:0006782</a>)</p> <p>GO - Cellular Component</p> <p>-</p> <p>No (<a href="https://www.gephebase.org/search-criteria?/and+Presumptive+Null=^No^#gephebase-summary-title">https://www.gephebase.org/search-criteria?/and+Presumptive+Null=^No^#gephebase-summary-title</a>)</p>	<p>Generic Gene Name</p> <p>Synonyms</p> <p>String</p> <p>Sequence Similarities</p> <p>GO - Molecular Function</p> <p>GO - Biological Process</p> <p>GO - Cellular Component</p>	<p>UniProtKB Amaranthus tuberculatus</p> <p>Q0NZW6 (<a href="http://www.uniprot.org/uniprot/Q0NZW6">http://www.uniprot.org/uniprot/Q0NZW6</a>)</p> <p>GenebankID or UniProtKB</p> <p>DQ386117 (<a href="https://www.ncbi.nlm.nih.gov/nucleotide/DQ386117">https://www.ncbi.nlm.nih.gov/nucleotide/DQ386117</a>)</p> <p>Presumptive Null</p>
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Coding (<https://www.gephebase.org/search-criteria?/and+Molecular+Type=%5Coding%5C#gephebase-summary-title>)

Molecular Type

Deletion (<https://www.gephebase.org/search-criteria?/and+Aberration+Type=%5CDeletion%5C#gephebase-summary-title>)

Aberration Type

1-9 bp

Deletion Size

3bp deletion; deletion of G210

Molecular Details of the Mutation

Linkage Mapping (<https://www.gephebase.org/search-criteria?/and+Experimental+Evidence=%5CLinkage+Mapping%5C#gephebase-summary-title>)

Experimental Evidence

A codon deletion confers resistance to herbicides inhibiting protoporphyrinogen oxidase. (2006) (<https://pubmed.ncbi.nlm.nih.gov/16894159>)

Main Reference

Patzoldt WL; Hager AG; McCormick JS; Tranel PJ

Authors

Herbicides that act by inhibiting protoporphyrinogen oxidase (PPO) are widely used to control weeds in a variety of crops. The first weed to evolve resistance to PPO-inhibiting herbicides was *Amaranthus tuberculatus*, a problematic weed in the midwestern United States that previously had evolved multiple resistances to herbicides inhibiting two other target sites. Evaluation of a PPO-inhibitor-resistant *A. tuberculatus* biotype revealed that resistance was a (incompletely) dominant trait conferred by a single, nuclear gene. Three genes predicted to encode PPO were identified in *A. tuberculatus*. One gene from the resistant biotype, designated PPX2L, contained a codon deletion that was shown to confer resistance by complementation of a hemG mutant strain of *Escherichia coli* grown in the presence and absence of the PPO inhibitor lactofen. PPX2L is predicted to encode both plastid- and mitochondria-targeted PPO isoforms, allowing a mutation in a single gene to confer resistance to two herbicide target sites. Unique aspects of the resistance mechanism include an amino acid deletion, rather than a substitution, and the dual-targeting nature of the gene, which may explain why resistance to PPO inhibitors has been rare.

Abstract

Additional References

## RELATED GEPHE

2 (ALS, EPSPS) (<https://www.gephebase.org/search-criteria?/or+Taxon+ID=%5C277990%5C/and+Trait=Xenobiotic+resistance/and+groupHaplotypes=true#gephebase-summary-title>)

Related Genes

No matches found.

Related Haplotypes

## EXTERNAL LINKS

## COMMENTS