

GEPHE SUMMARY

Gephebase Gene		GepheID
heavy metal atpase4 (HMA4) (https://www.gephebase.org/search-criteria?/and+Gene)		GP00000447
Gephebase~heavy metal atpase4 (HMA4)^#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	
Metal tolerance (https://www.gephebase.org/search-criteria?/and+Trait=^Metal)			
tolerance~#gephebase-summary-title)		Trait State in Taxon A	
Arabidopsis lyrata		Trait State in Taxon B	
Arabidopsis halleri		Ancestral State	
Taxon A		Taxonomic Status	
Interspecific (https://www.gephebase.org/search-criteria?/and+Taxonomic)			
Status~Interspecific^#gephebase-summary-title)			
Taxon A		Taxon B	
Latin Name		Latin Name	
Arabidopsis lyrata		Arabidopsis halleri	
(https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=^Arabidopsis)		(https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=^Arabidopsis)	
lyrata^#gephebase-summary-title)		halleri^#gephebase-summary-title)	
Common Name		Common Name	
-		-	
Synonyms		Synonyms	
lyrate rockcross; Arabidopsis lyrata (L.) O’Kane & Al-Shehbaz; Arabidopsis_lyrata		Arabis halleri; Cardaminopsis halleri; Arabidopsis halleri (L.) O’Kane & Al-Shehbaz; Arabis	
Rank		Rank	
species		species	
Lineage		Lineage	
cellular organisms; Eukaryota; Viridiplantae; Streptophyta; Streptophytina; Embryophyta;		cellular organisms; Eukaryota; Viridiplantae; Streptophyta; Streptophytina; Embryophyta;	
Tracheophyta; Euphyllophyta; Spermatophyta; Magnoliophyta; Mesangiospermae;		Tracheophyta; Euphyllophyta; Spermatophyta; Magnoliophyta; Mesangiospermae;	
eudicotyledons; Gunneridae; Pentapetalae; rosids; malvids; Brassicales; Brassicaceae;		eudicotyledons; Gunneridae; Pentapetalae; rosids; malvids; Brassicales; Brassicaceae;	
Camelineae; Arabidopsis		Camelineae; Arabidopsis	
Parent		Parent	
Arabidopsis () - (Rank: genus)		Arabidopsis () - (Rank: genus)	
(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=3701)		(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=3701)	
NCBI Taxonomy ID		NCBI Taxonomy ID	
59689		81970	
(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=59689)		(https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=81970)	
is Taxon A an Intraspecies?		is Taxon B an Intraspecies?	
No		No	

GENOTYPIC CHANGE

Generic Gene Name		UniProtKB Arabidopsis thaliana
HMA4		O64474 (http://www.uniprot.org/uniprot/O64474)
Synonyms		GenebankID or UniProtKB
ARABIDOPSIS HEAVY METAL ATPASE 4; ATHMA4; heavy metal atpase 4; T20K24.12; T20K24_12; At2g19110		CCM73193 (https://www.ncbi.nlm.nih.gov/nuccore/CCM73193)
String		
3702.AT2G19110.1		
(http://string-db.org/newstring.cgi/show_network_section.pl?identifier=3702.AT2G19110.1)		
Sequence Similarities		
Belongs to the cation transport ATPase (P-type) (TC 3.A.3) family. Type IB subfamily.		
GO - Molecular Function		
GO:0005524 : ATP binding (https://www.ebi.ac.uk/QuickGO/term/GO:0005524)		
GO:0046872 : metal ion binding (https://www.ebi.ac.uk/QuickGO/term/GO:0046872)		
GO:0005385 : zinc ion transmembrane transporter activity		
(https://www.ebi.ac.uk/QuickGO/term/GO:0005385)		
GO:0008551 : cadmium-exporting ATPase activity		

(<https://www.ebi.ac.uk/QuickGO/term/GO:0008551>)
GO:0016463 : zinc-exporting ATPase activity
(<https://www.ebi.ac.uk/QuickGO/term/GO:0016463>)
GO:0015086 : cadmium ion transmembrane transporter activity
(<https://www.ebi.ac.uk/QuickGO/term/GO:0015086>)

GO - Biological Process

GO:0030001 : metal ion transport (<https://www.ebi.ac.uk/QuickGO/term/GO:0030001>)
GO:0015691 : cadmium ion transport (<https://www.ebi.ac.uk/QuickGO/term/GO:0015691>)
GO:0046686 : response to cadmium ion
(<https://www.ebi.ac.uk/QuickGO/term/GO:0046686>)
GO:0032025 : response to cobalt ion (<https://www.ebi.ac.uk/QuickGO/term/GO:0032025>)
GO:0010038 : response to metal ion (<https://www.ebi.ac.uk/QuickGO/term/GO:0010038>)
GO:0010043 : response to zinc ion (<https://www.ebi.ac.uk/QuickGO/term/GO:0010043>)
GO:0055069 : zinc ion homeostasis (<https://www.ebi.ac.uk/QuickGO/term/GO:0055069>)
GO:0006829 : zinc ion transport (<https://www.ebi.ac.uk/QuickGO/term/GO:0006829>)

GO - Cellular Component

GO:0016021 : integral component of membrane
(<https://www.ebi.ac.uk/QuickGO/term/GO:0016021>)
GO:0005886 : plasma membrane (<https://www.ebi.ac.uk/QuickGO/term/GO:0005886>)
GO:0009506 : plasmodesma (<https://www.ebi.ac.uk/QuickGO/term/GO:0009506>)

	Presumptive Null
Unknown (https://www.gephebase.org/search-criteria?/and*Presumptive Null=~Unknown^#gephebase-summary-title)	
	Molecular Type
Unknown (https://www.gephebase.org/search-criteria?/and*Molecular Type=~Unknown^#gephebase-summary-title)	
	Aberration Type
Unknown (https://www.gephebase.org/search-criteria?/and*Aberration Type=~Unknown^#gephebase-summary-title)	
	Molecular Details of the Mutation
unknown	
	Experimental Evidence
Linkage Mapping (https://www.gephebase.org/search-criteria?/and*Experimental Evidence=~Linkage Mapping^#gephebase-summary-title)	
	Main Reference
A major quantitative trait locus for cadmium tolerance in <i>Arabidopsis halleri</i> colocalizes with HMA4, a gene encoding a heavy metal ATPase. (2007) (https://pubmed.ncbi.nlm.nih.gov/17434989)	
	Authors
Courbot M; Willems G; Motte P; Arvidsson S; Roosens N; Saumitou-Laprade P; Verbruggen N	

	Abstract
Cadmium (Cd) tolerance seems to be a constitutive species-level trait in <i>Arabidopsis halleri</i> sp. <i>halleri</i> . Therefore, an interspecific cross was made between <i>A. halleri</i> and its closest nontolerant interfertile relative, <i>Arabidopsis lyrata</i> sp. <i>petraea</i> , and a first-generation backcross population (BC1) was used to map quantitative trait loci (QTL) for Cd tolerance. Three QTL were identified, which explained 43%, 24%, and 16% of the phenotypic variation in the mapping population. Heavy metal transporting ATPases4 (HMA4), encoding a predicted heavy metal ATPase, colocalized with the peak of the major QTL Cdtol-1 and was consequently further studied. HMA4 transcripts levels were higher in the roots and the shoots of <i>A. halleri</i> than in <i>A. lyrata</i> sp. <i>petraea</i> . Furthermore, HMA4 was also more highly expressed in all BC1 genotypes harboring the HMA4 <i>A. halleri</i> allele at the QTL Cdtol-1, independently of the presence of an <i>A. halleri</i> allele at the two other QTL. Overexpression of AhHMA4 in yeast (<i>Saccharomyces cerevisiae</i>) supported a role of HMA4 in zinc (Zn) and Cd transport by reducing the Cd and Zn contents of the yeast cells. In epidermal tobacco (<i>Nicotiana tabacum</i>) cells, AhHMA4:green fluorescent protein was clearly localized in the plasma membrane. Taken together, all available data point to the elevated expression of HMA4 P(1B)-type ATPase as an efficient mechanism for improving Cd/Zn tolerance in plants under conditions of Cd/Zn excess by maintaining low cellular Cd(2+) and Zn(2+) concentrations in the cytoplasm.	
	Additional References

RELATED GEPHE

	Related Genes
1 (metal tolerance protein1) (https://www.gephebase.org/search-criteria?/or+Taxon ID=~59689^/and+Trait=Metal tolerance/or+Taxon ID=~81970^/and+Trait=Metal tolerance/and+groupHaplotypes=true#gephebase-summary-title)	
	Related Haplotypes
No matches found.	

EXTERNAL LINKS

COMMENTS

