

GEPHE SUMMARY

	Gephebase Gene	GephelD
heavy metal atpase3 (HMA3) (https://www.gephebase.org/search-criteria/?and+Gene Gephebase=^heavy metal atpase3 (HMA3)^#gephebase-summary-title)	GP00000446	Main curator
	Entry Status	Martin
Published		

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	
Thlaspi caerulescens - Ganges; Cd-accumulating	Trait State in Taxon B	
Thlaspi caerulescens - Prayon	Ancestral State	
Data not curated	Taxonomic Status	
Intraspecific (https://www.gephebase.org/search-criteria/?and+Taxonomic Status=^Intraspecific^#gephebase-summary-title)		
Taxon A		Taxon B
Noccea caerulescens (https://www.gephebase.org/search-criteria/?and+Taxon+and+Synonyms=^Noccea caerulescens^#gephebase-summary-title)	Latin Name	Latin Name
-	Common Name	Common Name
Thlaspi caerulescens; Noccea caerulescens (J.Presl & C.Presl) F.K.Mey., 1973; Thlaspi caerulescens J.Presl & C.Presl, 1819; Noccaeae caerulescens	Synonyms	Synonyms
species	Rank	Rank
cellular organisms; Eukaryota; Viriplantae; Streptophytina; Embryophyta; Tracheophyta; Euphylophyta; Spermatophytina; Magnoliophytina; Mesangiospermae; eudicotyledons; Gunneridae; Pentapetalae; rosids; malvids; Brassicales; Brassicaceae; Coluteoarpeae; Noccea	Lineage	Lineage
Noccea () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 290573)	Parent	Parent
107243 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 107243)	NCBI Taxonomy ID	NCBI Taxonomy ID
No	is Taxon A an Infraspecies?	is Taxon B an Infraspecies?
	Yes	Yes
		Taxon B Description
		Thlaspi caerulescens - Prayon

GENOTYPIC CHANGE

HMA3	Generic Gene Name	UniProtKB Arabidopsis thaliana
-	Synonyms	GenebankID or UniProtKB
-	String	
	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: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 - Biological Process

GO:0071585 : detoxification of cadmium ion

(<https://www.ebi.ac.uk/QuickGO/term/GO:0071585>)

GO - Cellular Component

GO:0016021 : integral component of membrane

(<https://www.ebi.ac.uk/QuickGO/term/GO:0016021>)GO:0005774 : vacuolar membrane (<https://www.ebi.ac.uk/QuickGO/term/GO:0005774>)

Presumptive Null

No (<https://www.gephebase.org/search-criteria/?and+Presumptive+Null=%No%#gephebase-summary-title>)

Molecular Type

Gene Amplification (<https://www.gephebase.org/search-criteria/?and+Molecular+Type=%Gene+Amplification%#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

Copy number Variant

Experimental Evidence

Candidate Gene (<https://www.gephebase.org/search-criteria/?and+Experimental+Evidence=%Candidate+Gene%#gephebase-summary-title>)

Main Reference

Elevated expression of TcHMA3 plays a key role in the extreme Cd tolerance in a Cd-hyperaccumulating ecotype of *Thlaspi caerulescens*. (2011) (<https://pubmed.ncbi.nlm.nih.gov/21457363>)

Authors

Ueno D; Milner MJ; Yamaji N; Yokosho K; Koyama E; Clemencia Zambrano M; Kaskie M; Ebbs S; Kochian LV; Ma JF

Abstract

Cadmium (Cd) is a highly toxic heavy metal for plants, but several unique Cd-hyperaccumulating plant species are able to accumulate this metal to extraordinary concentrations in the aboveground tissues without showing any toxic symptoms. However, the molecular mechanisms underlying this hypertolerance to Cd are poorly understood. Here we have isolated and functionally characterized an allelic gene, TcHMA3 (heavy metal ATPase 3) from two ecotypes (Ganges and Prayon) of *Thlaspi caerulescens* contrasting in Cd accumulation and tolerance. The TcHMA3 alleles from the higher (Ganges) and lower Cd-accumulating ecotype (Prayon) share 97.8% identity, and encode a P(1B)-type ATPase. There were no differences in the expression pattern, cell-specificity of protein localization and transport substrate-specificity of TcHMA3 between the two ecotypes. Both alleles were characterized by constitutive expression in the shoot and root, a tonoplast localization of the protein in all leaf cells and specific transport activity for Cd. The only difference between the two ecotypes was the expression level of TcHMA3: Ganges showed a sevenfold higher expression than Prayon, partly caused by a higher copy number. Furthermore, the expression level and localization of TcHMA3 were different from AtHMA3 expression in *Arabidopsis*. Overexpression of TcHMA3 in *Arabidopsis* significantly enhanced tolerance to Cd and slightly increased tolerance to Zn, but did not change Co or Pb tolerance. These results indicate that TcHMA3 is a tonoplast-localized transporter highly specific for Cd, which is responsible for sequestration of Cd into the leaf vacuoles, and that a higher expression of this gene is required for Cd hypertolerance in the Cd-hyperaccumulating ecotype of *T. caerulescens*.

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Additional References

RELATED GEPHE

Related Genes

No matches found.

Related Haplotypes

No matches found.

EXTERNAL LINKS

COMMENTS