GEPHE SUMMARY

Gephebase Gene
heavy metal atpase3 (HMA3) (https://www.gephebase.org/search-criteria?/and+Gene Gephebase=^heavy metal atpase3 (HMA3)^#gephebase-summary-title)

GepheID
GP00000446

Entry Status
Published

Main curator
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
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

Latin Name
Noccaea caerulescens (https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=^Noccaea caerulescens^#gephebase-summary-title)

Common Name
-

Synonyms
Thlaspi caerulescens; Noccaea caerulescens (J.Presl & C.Presl) F.K.Mey., 1973; Thlaspi caerulescens J.Presl & C.Presl, 1819; Noccaeae caerulescens

Rank
species

Lineage
cellular organisms; Eukaryota; Viridiplantae; Streptophyta; Streptophytina; Embryophyta; Tracheophyta; Euphyllophyta; Spermatophyta; Magnoliophyta; Mesangiospermae; eudicotyledons; Gunneridae; Pentapetalae; rosids; malvids; Brassicales; Brassicaceae; Coluteocarpeae; Noccaea

Parent
Noccaea () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 290573)

NCBI Taxonomy ID
107243 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 107243)

is Taxon A an Infraspecies?
No

Taxon B

Latin Name
Noccaea caerulescens (https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=^Noccaea caerulescens^#gephebase-summary-title)

Common Name
-

Synonyms
Thlaspi caerulescens; Noccaea caerulescens (J.Presl & C.Presl) F.K.Mey., 1973; Thlaspi caerulescens J.Presl & C.Presl, 1819; Noccaeae caerulescens

Rank
species

Lineage
cellular organisms; Eukaryota; Viridiplantae; Streptophyta; Streptophytina; Embryophyta; Tracheophyta; Euphyllophyta; Spermatophyta; Magnoliophyta; Mesangiospermae; eudicotyledons; Gunneridae; Pentapetalae; rosids; malvids; Brassicales; Brassicaceae; Coluteocarpeae; Noccaea

Parent
Noccaea () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 290573)

NCBI Taxonomy ID
107243 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 107243)

is Taxon B an Infraspecies?
Yes

Taxon B Description
Thlaspi caerulescens - Prayon

GENOTYPIC CHANGE

Generic Gene Name
HMA3

Synonyms
-

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)

UniProtKB Arabidopsis thaliana
P0CW78 (http://www.uniprot.org/uniprot/P0CW78)

GenebankID or UniProtKB
()

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.

Additional References

RELATED GEPHE

Related Genes

No matches found.

Related Haplotypes

No matches found.

EXTERNAL LINKS

COMMENTS