GEPHE SUMMARY

Gephebase Gene

ICARUS1 (https://www.gephebase.org/search-criteria?/and+Gene Gephebase=^ICARUS1^#gephebase-summary-title)

GepheID

GP00002066

Entry Status

Published

Main curator

Cao

PHENOTYPIC CHANGE

Trait #1

Trait Category

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

Trait

Plant growth (leaf morphology ; temperature-dependent) (https://www.gephebase.org/search-criteria?/and+Trait=^Plant growth (leaf morphology ; temperature-dependent)^#gephebase-summary-title)

Trait State in Taxon A

Arabidopsis thaliana - normal growth at high ambient temperature (27â€“28C)

Trait State in Taxon B

Arabidopsis thaliana - aberrant growth at high ambient temperature; reduced growth; smaller; pale and serrated leaves with reduced expansion of the leaf blade; altered phyllotaxy; plant architecture and severely impaired seed production

Trait #2

Trait Category

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

Trait

Hypersensitive to DNA damage (https://www.gephebase.org/search-criteria?/and+Trait=^Hypersensitive to DNA damage^#gephebase-summary-title)

Trait State in Taxon A

Arabidopsis thaliana - normal response to Bleomycin

Trait State in Taxon B

Arabidopsis thaliana - hypersensitive to Bleomycin, growth arrest of the first true leaves

Ancestral State

Taxon A

Taxonomic Status

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

Taxon A

Latin Name

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

Common Name

thale cress

Synonyms

thale cress; mouse-ear cress; thale-cress; Arabidopsis thaliana (L.) Heynh.; Arabidopsis thaliana (thale cress); Arabidopsis_thaliana; Arbisopsis thaliana; thale kress

Rank

species

Lineage

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

Parent

Arabidopsis () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 3701)

NCBI Taxonomy ID

3702 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 3702)

is Taxon A an Infraspecies?

No

Taxon B

Latin Name

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

Common Name

thale cress

Synonyms

thale cress; mouse-ear cress; thale-cress; Arabidopsis thaliana (L.) Heynh.; Arabidopsis thaliana (thale cress); Arabidopsis_thaliana; Arbisopsis thaliana; thale kress

Rank

species

Lineage

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

Parent

Arabidopsis () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 3701)

NCBI Taxonomy ID

3702 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 3702)

is Taxon B an Infraspecies?

No

GENOTYPIC CHANGE

Generic Gene Name

ICA1

Synonyms

At2g31580

String

-

Sequence Similarities

-

GO - Molecular Function

GO:0000287 : magnesium ion binding (https://www.ebi.ac.uk/QuickGO/term/GO:0000287)
GO:0008193 : tRNA guanylyltransferase activity (https://www.ebi.ac.uk/QuickGO/term/GO:0008193)

GO - Biological Process

GO:0006400 : tRNA modification (https://www.ebi.ac.uk/QuickGO/term/GO:0006400)

GO - Cellular Component

GO:0016021 : integral component of membrane (https://www.ebi.ac.uk/QuickGO/term/GO:0016021)

UniProtKB Arabidopsis thaliana

A0A0F7PXK5 (http://www.uniprot.org/uniprot/A0A0F7PXK5)

GenebankID or UniProtKB Arabidopsis thaliana

A0A0F7PXK5 (https://www.ncbi.nlm.nih.gov/nuccore/A0A0F7PXK5)

Mutation #1

Presumptive Null

Yes (https://www.gephebase.org/search-criteria?/and+Presumptive Null=^Yes^#gephebase-summary-title)

Molecular Type

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

Aberration Type

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

SNP Coding Change

Nonsynonymous

Molecular Details of the Mutation

ICARUS1 (ICA1) encodes a protein of the tRNA(His) guanylyl transferase (Thg1) superfamily. ICA1 loss-of-function results in down regulation of cell cycle associated genes at high temperatures, which is linked with a block in G2/M transition and endoreduplication; plants with mutations in ICA1 show enhanced sensitivity to DNA damage

Experimental Evidence

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

	Taxon A	Taxon B	Position
Codon	-	-	-
Amino-acid	Ser	Pro	81

Main Reference

Natural Variation Identifies ICARUS1, a Universal Gene Required for Cell Proliferation and Growth at High Temperatures in Arabidopsis thaliana. (2015) (https://pubmed.ncbi.nlm.nih.gov/25951176)

Authors

Zhu W; Ausin I; Seleznev A; MÃ©ndez-Vigo B; PicÃ³ FX; Sureshkumar S; Sundaramoorthi V; Bulach D; Powell D; Seemann T; Alonso-Blanco C; Balasubramanian S

Abstract

Plants are highly sensitive to environmental changes and even small variations in ambient temperature have severe consequences on their growth and development. Temperature affects multiple aspects of plant development, but the processes and mechanisms underlying thermo-sensitive growth responses are mostly unknown. Here we exploit natural variation in Arabidopsis thaliana to identify and characterize novel components and processes mediating thermo-sensitive growth responses in plants. Phenotypic screening of wild accessions identified several strains displaying pleiotropic growth defects, at cellular and organism levels, specifically at high ambient temperatures. Positional cloning and characterization of the underlying gene revealed that ICARUS1 (ICA1), which encodes a protein of the tRNAHis guanylyl transferase (Thg1) superfamily, is required for plant growth at high temperatures. Transcriptome and gene marker analyses together with DNA content measurements show that ICA1 loss-of-function results in down regulation of cell cycle associated genes at high temperatures, which is linked with a block in G2/M transition and endoreduplication. In addition, plants with mutations in ICA1 show enhanced sensitivity to DNA damage. Characterization of additional strains that carry lesions in ICA1, but display normal growth, shows that alternative splicing is likely to alleviate the deleterious effects of some natural mutations. Furthermore, analyses of worldwide and regional collections of natural accessions indicate that ICA1 loss-of-function has arisen several times independently, and that these occur at high frequency in some local populations. Overall our results suggest that ICA1-mediated-modulation of fundamental processes such as tRNAHis maturation, modify plant growth responses to temperature changes in a quantitative and reversible manner, in natural populations.

Additional References

Mutation #2

Presumptive Null

Yes (https://www.gephebase.org/search-criteria?/and+Presumptive Null=^Yes^#gephebase-summary-title)

Molecular Type

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

Aberration Type

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

Deletion Size

1-9 bp

Molecular Details of the Mutation

This mutation (position T490*) is predicted to shift the reading frame and generate a short truncated protein of 31 amino acids. However mutations are suppressed by alternative

splicing. Alternative splicing enables the natural intragenic suppression of an otherwise ICA1 loss-of-function allele.

Experimental Evidence

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

Main Reference

Natural Variation Identifies ICARUS1, a Universal Gene Required for Cell Proliferation and Growth at High Temperatures in Arabidopsis thaliana. (2015) (https://pubmed.ncbi.nlm.nih.gov/25951176)

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Additional References

RELATED GEPHE

Related Genes

5 (EARLY FLOWERING 3(ELF3) [possible pseudo-replicate], Enhanced shoot growth under mannitol stress 2 (EGM2), IIL1, TZP, FUMARASE 2) (https://www.gephebase.org/search-criteria?/or+Taxon ID=^3702^/and+Trait=Plant growth/or+Taxon ID=^3702^/and+Trait=Hypersensitive to DNA damage/and+groupHaplotypes=true#gephebase-summary-title)

Related Haplotypes

No matches found.

EXTERNAL LINKS

COMMENTS

@Splicing @Pleiotropy