

GEPHE SUMMARY

|   |                |            |              |
|---|----------------|------------|--------------|
| ICARUS1 ( <a href="https://www.gephebase.org/search-criteria?/and+GeneGephebase=^ICARUS1^#gephebase-summary-title">https://www.gephebase.org/search-criteria?/and+GeneGephebase=^ICARUS1^#gephebase-summary-title</a> ) | Gephebase Gene | GP00002066 | GepheID      |
| Published   | Entry Status   | Cao        | Main curator |

PHENOTYPIC CHANGE

|  |                        |
|--|------------------------|
| Trait #1   | Trait Category         |
| Physiology ( <a href="https://www.gephebase.org/search-criteria?/and+TraitCategory=^Physiology^#gephebase-summary-title">https://www.gephebase.org/search-criteria?/and+TraitCategory=^Physiology^#gephebase-summary-title</a> )   | Trait                  |
| Plant growth (leaf morphology ; temperature-dependent) ( <a href="https://www.gephebase.org/search-criteria?/and+Trait=^Plant growth (leaf morphology ; temperature-dependent)^#gephebase-summary-title">https://www.gephebase.org/search-criteria?/and+Trait=^Plant growth (leaf morphology ; temperature-dependent)^#gephebase-summary-title</a> ) | Trait State in Taxon A |
| Arabidopsis thaliana - normal growth at high ambient temperature (27±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 ( <a href="https://www.gephebase.org/search-criteria?/and+TraitCategory=^Physiology^#gephebase-summary-title">https://www.gephebase.org/search-criteria?/and+TraitCategory=^Physiology^#gephebase-summary-title</a> )                                       | Trait                  |
| Hypersensitive to DNA damage ( <a href="https://www.gephebase.org/search-criteria?/and+Trait=^Hypersensitive to DNA damage^#gephebase-summary-title">https://www.gephebase.org/search-criteria?/and+Trait=^Hypersensitive to DNA damage^#gephebase-summary-title</a> ) | 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   |                        |

|  |                  |  |                  |
|--|------------------|--|------------------|
| Taxon A  | Ancestral State  | Taxon B  |                  |
| Intraspecific ( <a href="https://www.gephebase.org/search-criteria?/and+TaxonomicStatus=^Intraspecific^#gephebase-summary-title">https://www.gephebase.org/search-criteria?/and+TaxonomicStatus=^Intraspecific^#gephebase-summary-title</a> )                                      | Taxonomic Status |  |                  |
| Arabidopsis thaliana ( <a href="https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=^Arabidopsis thaliana^#gephebase-summary-title">https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=^Arabidopsis thaliana^#gephebase-summary-title</a> )           | Latin Name       | Arabidopsis thaliana ( <a href="https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=^Arabidopsis thaliana^#gephebase-summary-title">https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=^Arabidopsis thaliana^#gephebase-summary-title</a> )           | Latin Name       |
| thale cress  | Common Name      | thale cress  | Common Name      |
| thale cress; mouse-ear cress; thale-cress; Arabidopsis thaliana (L.) Heynh.; Arabidopsis thaliana (thale cress); Arabidopsis_thaliana; Arbisopsis thaliana; thale kress  | Synonyms         | thale cress; mouse-ear cress; thale-cress; Arabidopsis thaliana (L.) Heynh.; Arabidopsis thaliana (thale cress); Arabidopsis_thaliana; Arbisopsis thaliana; thale kress  | Synonyms         |
| species  | Rank             | species  | Rank             |
| cellular organisms; Eukaryota; Viridiplantae; Streptophyta; Streptophytina; Embryophyta; Tracheophyta; Euphyllophyta; Spermatophyta; Magnoliophyta; Mesangiospermae; eudicotyledons; Gunneridae; Pentapetales; rosids; malvids; Brassicales; Brassicaceae; Camelineae; Arabidopsis | Lineage          | cellular organisms; Eukaryota; Viridiplantae; Streptophyta; Streptophytina; Embryophyta; Tracheophyta; Euphyllophyta; Spermatophyta; Magnoliophyta; Mesangiospermae; eudicotyledons; Gunneridae; Pentapetales; rosids; malvids; Brassicales; Brassicaceae; Camelineae; Arabidopsis | Lineage          |
| Arabidopsis () - (Rank: genus) ( <a href="https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 3701">https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 3701</a> )   | Parent           | Arabidopsis () - (Rank: genus) ( <a href="https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 3701">https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 3701</a> )   | Parent           |
| 3702 ( <a href="https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 3702">https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 3702</a> )   | NCBI Taxonomy ID | 3702 ( <a href="https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 3702">https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 3702</a> )   | NCBI Taxonomy ID |
| is Taxon A an Intraspecies?  |                  | is Taxon B an Intraspecies?  |                  |
| No   |                  | No   |                  |

GENOTYPIC CHANGE

|           |   |                                |
|-----------|---|--------------------------------|
| ICA1      | Generic Gene Name   | UniProtKB Arabidopsis thaliana |
|           | A0A0F7P XK5 ( <a href="http://www.uniprot.org/uniprot/A0A0F7P XK5">http://www.uniprot.org/uniprot/A0A0F7P XK5</a> )   |                                |
| At2g31580 | Synonyms  | GenebankID or UniProtKB        |
|           | String  | Arabidopsis thaliana           |
| -         |   |                                |
| -         | Sequence Similarities   |                                |
|           |   |                                |
|           | GO - Molecular Function   |                                |
|           | GO:0000287 : magnesium ion binding<br>( <a href="https://www.ebi.ac.uk/QuickGO/term/GO:0000287">https://www.ebi.ac.uk/QuickGO/term/GO:0000287</a> )             |                                |
|           | GO - Biological Process   |                                |
|           | GO:0008193 : tRNA guanylyltransferase activity<br>( <a href="https://www.ebi.ac.uk/QuickGO/term/GO:0008193">https://www.ebi.ac.uk/QuickGO/term/GO:0008193</a> ) |                                |
|           | GO - Cellular Component   |                                |
|           | GO:0006400 : tRNA modification ( <a href="https://www.ebi.ac.uk/QuickGO/term/GO:0006400">https://www.ebi.ac.uk/QuickGO/term/GO:0006400</a> )                    |                                |
|           |   |                                |
|           | GO:0016021 : integral component of membrane<br>( <a href="https://www.ebi.ac.uk/QuickGO/term/GO:0016021">https://www.ebi.ac.uk/QuickGO/term/GO:0016021</a> )    |                                |

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; Mandez-Vigo B; Pic 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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Abstract

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Additional References

RELATED GEPHE

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 Genes

No matches found.

Related Haplotypes

EXTERNAL LINKS

COMMENTS

@Splicing @Pleiotropy