**Supplementary file 13** Functions and references associated with abiotic stress and immune responses, organ developments of male-biased genes under significant relaxed selection (*P-value* < 0.05) in floral buds.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| OGs | Function Description | Signal\* | Stress responses/Developments | References |
| OG0008899 | Non-canonical poly(A) RNA polymerase protein Trf4 | R |  |  |
| **OG0007568** | quinolinate synthase (QS) | R | salt | Wei *et al.* (2020) |
| **OG0008786** | basic 7S globulin-like protein | R | antibacterial, allergen, heat | Hirano (2021) |
| **OG0008247** | Homogentisate phytyltransferase 1 (HPT1) | R | light, oxidative, nutrient starvation | Collakova and DellaPenna (2003) |
| **OG0006131** | LOB domain-containing protein 18 (LBD18) | R | heat, light, pathogens, lateral roots formation, callus formation | Zhang *et al.* (2020); Liu *et al.* (2019) |
| **OG0007549** | WRKY transcription factor 72 (WRKY72) | R | salt, drought, heat, ABA, osmotic, pathogens, sugar starvation | Chen *et al.* (2017); Chen *et al.* (2012); Li *et al.* (2020) |
| ***OG0008560*** | CLAVATA3/ESR (CLE)-related protein 13(CLV3/CLE13) | R | cold, heat, drought, salt, cytokinin, hormonal, floral organ, stamen, anther, root, shoot | Zhang *et al.* (2022); Lin *et al.* (2021); Cui *et al.* (2022); Jun *et al.* (2010); Laffont *et al.* (2020) |
| **OG0009366** | glycosyltransferase family protein 64 C3 (GT64-C3) | R | terrestrial environment | Caputi *et al.* (2012) |
| **OG0008638** | E3 ubiquitin-protein ligase AIRP2 (AIRP2) | R | abscisic acid (ABA), drought | Yu *et al.* (2016); Cho *et al.* (2011) |
| OG0008572 | uncharacterized protein | R |  |  |
| **OG0008611** | AUXIN SIGNALING F-BOX 2 (AFB2) | R | drought, salt, oxidative | Verma *et al.* (2022); Iglesias *et al.* (2010) |
| **OG0007091** | ethylene-responsive transcription factor ERF060 | R | alpine environment | Ma *et al.* (2015) |
| **OG0008547** | phosphorelay response regulator | R | cytokinins, ethylene, abscisic acid, light, temperature | Skalak *et al.* (2021) |
| OG0006106 | uncharacterized protein | R |  |  |
| **OG0006323** | Glycosyltransferase family 92 protein (GT92) | R | terrestrial environment | Ebert *et al.* (2018); Caputi *et al.* (2012) |
| **OG0007242** | subtilisin-like protease SBT1.4 | R | osmotic | Stührwohldt *et al.* (2021) |
| OG0009543 | mediator of RNA polymerase II transcription subunit 25 | R |  |  |
| ***OG0008341*** | pollen receptor-like kinase 3 (PRK3) | R | pollen development, pollen grain, pollen maturation | Kim *et al.* (2021); Muschietti and Wengier (2018); Takeuchi and Higashiyama (2016); Kim *et al.* (2002) |

OGs in bold font are associated with biotic and abiotic stress responses. OGs in bold and italic fonts are associated with pollen developments and maturation.

Asterisk (\*) indicates that relaxed selections are tested by RELAX (R).

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