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(54) **METHODS AND COMPOSITIONS FOR TRANSGENIC PLANTS WITH ENHANCED COLD TOLERANCE, ABILITY TO FLOWER WITHOUT VERNALIZATION REQUIREMENT AND IMPACTED FERTILITY**

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(58) **Field of Classification Search**
None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2006/0123505 A1* 6/2006 Kikuchi C07K 14/415
800/278
2012/0278929 A1* 11/2012 Baum C12N 15/8285
800/265

OTHER PUBLICATIONS

Ashraf et al. "Roles of glycine betaine and proline in improving plant abiotic stress resistance" *Environmental and Experimental Botany* 59(2):206-216 (2007) (Abstract only).
Chen et al. "Expression of a cloned sweet potato catalase SPCAT1 alleviates ethephon-mediated leaf senescence and H₂O₂ elevation" *Journal of Plant Physiology* 169(1):86-97 (2012) (Abstract only).

Kwon et al. "Molecular cloning, characterization and expression analysis of a catalase cDNA from hot pepper (*Capsicum annuum* L.)" *Plant Science* 160(5):961-969 (2001) (Abstract only).

Li et al. "Overexpression of tomato SpMPK3 gene in *Arabidopsis* enhances the osmotic tolerance" *Biochemical and Biophysical Research Communications* 443(2):357-362 (2014) (Abstract only).
Nuruzzaman et al. "Genome-wide analysis of NAC transcription factor family in rice" *Gene* 465(1-2):30-44 (2010) (Abstract only).
Pignocchi et al. "Apoplastic ascorbate metabolism and its role in the regulation of cell signalling" *Current Opinion in Plant Biology* 6(4):379-389 (2003) (Abstract only).

Véry et al. "Cation channels in the *Arabidopsis* plasma membrane" *Trends in Plant Science* 7(4):168-175 (2002) (Abstract only).

Wang et al. "Enhanced drought tolerance of transgenic rice plants expressing a pea manganese superoxide dismutase" *Journal of Plant Physiology* 162:465-472 (2005).

Yuan et al. "Constitutive Expression of Rice MicroRNA528 Alters Plant Development and Enhances Tolerance to Salinity Stress and Nitrogen Starvation in Creeping Bentgrass" *Plant Physiology* 169:576-593 (2015).

Abràmoff et al. "Image Processing with ImageJ" *Biophotonics International* 11:36-43 (2004).

Ali et al. "Effect of salinity on chlorophyll concentration, leaf area, yield and yield components of rice genotypes grown under saline environment" *International Journal of Environmental Science & Technology* 1(3):221-225 (2004).

An et al. "Sequencing-Based Approaches Reveal Low Ambient Temperature-Responsive and Tissue-Specific MicroRNAs in *Phalaenopsis* Orchid" *PLoS One* 6(5):e18937 (2011).

Bates et al. "Rapid determination of free proline for water-stress studies" *Plant and Soil* 39:205-207 (1973).

Baxter et al. "A Coastal Cline in Sodium Accumulation in *Arabidopsis thaliana* Is Driven by Natural Variation of the Sodium Transporter AtHKT1;1" *PLoS Genetics* 6(11):e1001193 (2010).

Becker et al. "Differences in gene expression between natural and artificially induced leaf senescence" *Planta* 189:74-79 (1993).

Bhardwaj et al. "A Genome-Wide Perspective of miRNAome in Response to High Temperature, Salinity and Drought Stresses in *Brassica juncea* (Czern) L." *PLoS One* 9(3):e92456 (2014).

Buchanan-Wollaston et al. "Comparative transcriptome analysis reveals significant differences in gene expression and signalling pathways between developmental and dark/starvation-induced senescence in *Arabidopsis*" *The Plant Journal* 42:567-585 (2005).

Chapin et al. "Growth response of barley and tomato to nitrogen stress and its control by abscisic acid, water relations and photosynthesis" *Planta* 173:352-366 (1988).

Crété et al. "Nitrite reductase expression is regulated at the post-transcriptional level by the nitrogen source in *Nicotiana glauca* and *Arabidopsis thaliana*" *The Plant Journal* 11(4):625-634 (1997).

Cui et al. "The miR156-SPL9-DFR pathway coordinates the relationship between development and abiotic stress tolerance in plants" *The Plant Journal* 80:1108-1117 (2014).

(Continued)

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(57) **ABSTRACT**

The present invention provides transgenic plants having increased tolerance to cold and altered flowering characteristics. Also provided are methods and compositions for producing said transgenic plants.