Current Genomics
BENTHAM SCIENCE PUBLISHERS LTD.

PMC full text: Curr Genomics. 2011 Mar; 12(1): 30–43.
doi: 10.2174/138920211794520178

Table 1

Selective Reports on Production of Cold Stress-Tolerant Transgenic Crops

Gene (s) / Gene product	Cellular role	Transgenic Host-Plant	Performance of transgenic plants	Reference
gpat Glycerol 3-phosphate acyltransferase	Fatty acidunsaturation	*N. tabacum*	Transformants showed less chilling damage to photosynthetic activity than the wild type	[86]
sod Superoxide dismutase	Dismutation of toxic reactive oxygen intermediate	*N. tabacum*	Transformants showed 20% higher photosynthetic activity during chilling compared to untransformed plants	[116]
sacB Levan sucrase	Fructan biosynthesis	*N.tabacum*	Transformants were more tolerant to freezing and *PEG*-mediated water stress than the wild type	[117]
cor15a Cold regulated gene	Promotes freezing tolerance	*A. thaliana*	Transformants showed *in vivo* enhanced freezing tolerance of protoplasts and the chloroplasts	[64]
mn-sod Mn-Superoxide dismutase	Dismutation of reactiveoxygen inter mediates in mitochondria	*M. sativa*	Transformants showed reduced injury from water deficit stress and increased winter survival	[118]
gst/gpx Glutathione-Stransferase and glutathione peroxidase	Detoxification of herbicides and toxic substances	*N.tabacum*	Transformants over-expressing *GST/GPX* showed stimulated seedling growth under chilling and salt stress	[119]
cbf1 CRT/DRE binding factor	Transcription factor	*A. thaliana*	Transformants showed regulation of several *cor* genes at the same time and showed freezing tolerance	[76]
dreb1 anddreb2 DRE-binding Protein	Transcription factor	*A. thaliana*	Transformants revealed freezing and dehydration tolerance but caused dwarfed phenotypes in transgenic plants	[81]
WCS120/COR39 CCGAC sequences like CRT/DREs in its promoter	Low temperature regulated gene	*Trtricum sativum*	cold inducible in monocotyledonous and dicotyledonous plants	[120]

Gene (s) / Gene product	Cellular role	Transgenic Host-Plant	Performance of transgenic plants	Reference
codA Choline oxidase A	Glycinebetaine biosynthesis	*O. sativa*	Transformants accumulated high levels of glycinebetaine and showed increased tolerance to salt and low temperature stress	[121]
codA Choline oxidase A	Glycinebetaine biosynthesis	*A. thaliana*	Transformants were tolerant to salt and cold	[122]
DREB1A (CBF3) DRE-binding protein	Transcription factor	*Arabidopsis*	Increased salt, drought and cold tolerance in nonacclimated plants	[75]
prodh Proline dehydrogenase	Proline biosynthesis	*A. thaliana*	The antisense transgenics were more tolerant to freezing and high salinity than wild types	[123]
CBF3 DRE-binding protein	Transcription factor	*Arabidopsis*	Increased freezing tolerance of cold- acclimated plants	[5]
ala1 Aminophospholipid ATPase 1	P-type ATPase (Transporter protein)	*A. thaliana*	Transformants showing down regulation results in cold-affected plants that are much smaller than the wild type	[34]
*SCOF1*cold-inducible zinc finger protein	Regulator of *SGBF-1* as a transcription factor	*Glycine max*	activate *COR* gene expression and increase freezing tolerance in non-acclimated transgenic plants	[102]
abi3 Abscisic acid induced protein	Transcription factor	*A. thaliana*	Marked increase in expression of low temperature-induced freezing tolerance accompanied by up-regulation of *RAB18, LTI129, LTI130 and LTI178*	[13]
*CuCOR19*citrus dehydrin	Inhibition of lipid peroxidation	*N. tabacum*	Increased the cold tolerance	[89]
*CBF1/ DREB1b*DRE-binding protein	Transcription factor	*O. sativa*	The cold-responsive genes lip5, lip9, and OsDhn1 were up-regulated in the transgenic plants	[124]
DREB1A (*rd29A)* DRE-binding protein	Stress-inducible promoter	*N. tabacum*	Improved drought and low-temperature stress tolerance	[83]
OSISAP1 Zinc-finger protein	Transcription factor	*N. tabacum*	The transcript level of *OSISAP*1 was increased to a very high level during a 12-h cold treatment	[125]
Osmyb4	Transcription factor	*Arabidopsis*	Increases chilling and freezing tolerance	[126]
HOS10 Encodes an R2R3-type protein	Transcription factor	*O. sativa*	Enhanced cold tolerance	[127]
ZAT12 C2H2 zinc finger	Transcription factor	*Arabidopsis*	Improved cold acclimation	[55]
*Cor15am*Chloroplast stromal protein	Stress-inducible promoter	*Arabidopsis*	Enhanced cryoprotective activity	[128]
OsMYB3R-2 DNA-binding domain	Transcription factor	*Arabidopsis*	Overexpression of *OsMYB3R-2* leads to increased tolerance to freezing, drought, and salt stress	[93]

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*ACBP6*Acyl-CoA-binding protein	Decline in phosphatidylcholine and elevation of phosphatidic acid	*Arabidopsis*	Overexpression of *ACBP6* enhances freezing tolerance	[129]
OsMYB3R-2 DNA-binding domain	Transcription factor	*O. sativa*	Overexpression of OsMYB3R-2 exhibited enhanced cold tolerance	[130]
AtCSP3 Cold shock protein	RNA chaperon	*Arabidopsis*	Transgenic plants conferred enhanced freezing tolerance as compared to wild type plants hence demonstrating essential role of RNA chaperones for cold adaptation in higher plants	[131]
MYBS3 DNA-binding repeat MYB	Transcription factor	*O. sativa*	Plays a critical role in cold adaptation in rice	[99]
*mybc1*Regulate osmotic stress tolerance	Transcription factor	*Arabidopsis*	Exhibited an increased tolerance to freezing stress	[132]
ThpI Thermal hysteresis proteins (Anti freeze protein)	Transcription factor	*Arabidopsis*	Enhanced low temperature tolerance in transgenic plants was observed by changes of electrolyte leakage activity, malonyldialdehyde and proline contents	[133]
CBF1 CRT/DRE binding factor 1	Transcription factor	*Solanum Lycopersicum*	Detection of higher activity of superoxide dismutase (SOD), higher non-photochemical quenching (NPQ), and lower malondialdehyde (MDA) content in transgenic tomato leaves suggest that CBF1 protein plays an important role in protection of PSII and PSI during low temperature stress at low irradiance	[108]