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REVIEW

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Signal transduction and transcriptome engineering in plants: A review

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ABSTRACT

Transcriptome engineering of a master switch gene that regulate several target genes. Some genes viz. SOS3, HKT1, NHX1, MAPKKK, CDPK etc. are responsible for overexpression in transgenic plants exhibited enhanced in abiotic stress. Each genes are activated by some special cis- acting regulatory elements in osmotic- and cold-stress responsive promoters.

INTRODUCTION

Signaling components and transcription factors activates many genes. In this paper we listed out some important genes, use of these genes in transgenic will be of great use because simply by introducing single gene in transgenic results in modified expression of several target genes. Transcriptome engineering of a master switch gene that regulate several target genes coding for LEA Proteins, ROS detoxification etc. Many eukaryotic microorganisms use chemical signals in cell-cell communication. The receptor initiates one or more sequences of biochemical reactions that connect the stimulus to a cellular response. Such a sequence reaction is called Signal transduction pathway. Perception of stress cues and relay of the signals to switch on adaptive responses are the key steps leading to stress tolerence. As a result, differences in stress tolerence between genotypes or different developmental stages of a single genotype may arise from differences in signal perception and transduction mechanisms. Application of molecular genetic analysis led to the identification of some of component of abiotic stress signal transduction.

Each genes are activated by some special cis- acting regulatory elements in osmotic- and cold-stress responsive promoters. Osmotic stress signal under drought / salinity stress is probably perceived by a putative two component hybrid type histidine kinase[25] and receptor like kinase[24]. ABA dependent signaling activates basic leucine zipper transcription factors called ABFs/ AREBs to induce stress responsive gene expression. Drought stress receptorsmay tranduce the signal through calcium sensor proteins and motigen activated protein kinase module to activate trancription factors[1,3,26,]. Transcription factor belongs to the Ethylene-responsive element binding protein (EREBP) known as C-repeat binding factors (CBFs)or dehydration responsive element binding factors (DREBs) that control gene expression containing DRE/CRT cis-elements.

Conclusions and perspectives

Genetic engineering to develop stress tolerant transgenic plants are signaling molecules, transcription factors and tolerance effectors. Over-expression of metabolites, stress responsive genes or signaling components often results in continuous diversion of energy. The use of tissue and organ specific promoters thus

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In transgenic plants, transcriptome engineering to improve abiotic stress resistance of plants are listed as follows

Gene	Function	Validation	Reference
AtABF3	ABRE-binding bZIP transcription factor	Overexpression in transgenic rice exhibited enhanced drought tolerance	Ref. [14]
AtDREB1A	C-repeat/ DRE binding factor 3	Overexpression in transgenic rice enhanced tolerance to abiotic stress	Ref. [14]
AtABF4, AREB2	ABRE-binding bZIP transcription factor	Overexpression in transgenic Arabidopsis exhibited ABA hypersensitivity, reduced transcription and enhanced drought tolerence	Ref. [8]
AtAZF2, AtSTZ	Cys2/His2-Type Zinc-Finger Proteins; Repressors	Overexpression in reduced growth and enhanced drought resistance	Ref. [19]
Petunia ZPT2-3	Cys2/His2-type zinc finger protein	Overexpression in dehydration tolerance	Ref. [22]
NtNPK1	Mitogen-activated protein kinase kinase kinase (MAPKKK) which activate AtMPK3 and AtMPK6	Overexpression in Maize: Drought resistance of photosynthesis; stability in grain weight under drought; Tobacco: tolerance of freezing, heat and salinity stress	Ref. [20,11]
AtGF14	a 14-3-3 protein	Transgenic cotton plants showed a "stay-green" phenotype and improved and improved water-stress tolerance	Ref. [26]
AtCaMBP25	Calmodulin binding protein	Overexpression in transgenic plants hypersensitive to salt and osmotic stress	Ref. [16]
OsCDPK7	Calcium dependent protein kinase	Overexpression in rice transgenics induced the expression of RAB16; enhanced tolerance to cold, salt and drought	Ref. [18]
AtCBL1	SOS3- like Calcium sensor protein	Overexpression in transgenic Arabidopsis enhanced drought induced gene expression	Ref. [2]
NtRLK	Receptor like kinase	Overexpression in tobacco enhanced the osmotic stress tolerance	Ref. [23]
AtCBF1	C-repeat/DRE binding factor1	Overexpression in Arabidopsis causes constitutive freezing and drought tolerance	Ref. [12, 21,7]
AtCBF1	C-repeat/DRE binding factor1	Overexpression in tomato transgenic enhanced resistance to water deficit stress	Ref. [6]
AtCBF2	C-repeat/DRE binding factor2	Increase expression of CBF1 and CBF3 for cold, dehydration and salt tolerance	Ref. [13]
AtDREB1A	C-repeat/DRE binding factor	Overexpression in transgenic wheat increase tolerance to drought stress	Ref. [15]
AtDREB1A	C-repeat/DRE binding factor	Overexpression in transgenic Arabidopsis inducetarget COR genes and conferred enhanced tolerance to drought and cold stress	Ref. [17,4]
AtABF3, DPBF5	ABRE-binding bZIP transcription factor	Overexpression in ABA hypersensitivity, enhanced drought tolerance in Arabidopsis	Ref. [8]
AtCBF3, DREB1A	C-repeat/DRE binding factor 3	Overexpression in Arabidopsis increase tolerance to drought and cold stress	Ref. [12,5,9]
DREB1A	C-repeat/DRE binding factor 3	Overexpression in tobacco enhances tolerance to drought and chilling stress	Ref. [10]

appears vital for abiotic stress tolerance in transgenic crop plants. Reproductive phase are more sensitive to these abiotic stressthan Vegetative phase. Hence, Stress inducible promoter driven trangenes may confer better stress resistance than the constitutive promoter.

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