



**BCIL** *seeks partners to license...*

## ***Abiotic Stress Tolerant Genes for Developing Drought Resistant Transgenic Plants***

Biotech Consortium India Limited (BCIL) is seeking companies interested in licensing the technology for producing abiotic stress tolerant transgenic plants for cultivation in drought and high saline conditions. The method provides for the production of pure lines of transgenic with increased expression of stress tolerant genes such as Cu/Zn Superoxide dismutase (AmSOD1); Ferritin (Fer1), Dehydrin (AmDHN); Am244; Phytosulfokine peptide precursor, ascorbate peroxidase (Am-pAPX1), monodehydroascorbate reductase (MDAR), NAC transcription factor (AmNAC1), antiporter (PcNHX1). The technology has been developed by Dr. Ajay Parida and his team at M. S. Swaminathan Research Foundation, Chennai, India, keeping in view the decreased productivity of agricultural systems and food production worldwide due to abiotic stress.

### **About BCIL:**

BCIL was incorporated as public limited company in 1990 under the Indian Companies Act 1956. It is promoted by the Department of Biotechnology, Government of India and is financed by several all India financial institutions, venture capital funds and the corporate sector. BCIL has been actively involved in technology transfer, project consultancy, fund syndication, information dissemination, and manpower training & placement related to biotechnology over the last two decades. BCIL has transferred more than 15 technologies in the last 5 years using its expertise in facilitating licensing agreements that allow healthy and productive cooperation between the inventor and the licensee.

### **Technology Background and Description**

To address the problem of abiotic stress, specifically pertaining to salt and drought stress, scientists at MSSRF have identified novel genes from the mangrove species, *Avicennia marina* for developing abiotic stress tolerant transgenic plants.



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The present technology provides nucleotide sequences of *Cu/Zn superoxide dismutase (AmSOD)1*, *ferritin (Fer1)*, *dehydrin (AmDHN)*, *stress tolerant (Am244)*, *phytosulfokine peptide precursor*, *ascorbate peroxidase (Am-pAPX1)* and *monodehydroascorbate reductase (MDAR)*, *NAC transcription factor (AmNAC1)* from *Avicennia marina*; *antiporter gene (PcNHX1)* from *Porteresia coarctata* and a method for producing abiotic stress tolerant transgenic plants, more specifically salt and/or drought stress tolerant transgenic plants by expression of the said genes in rice and other plant species. The transgenic plants showed an increase in yield and withstood salinity stress of 300 mM of NaCl and drought condition for a period of eight days.

### **Technology Features and Advantages**

- Abiotic stress tolerant genes for salt and drought resistance from the mangrove species, *Avicennia marina* which are listed as follows
  - *Cu/Zn Superoxide dismutase- AmSOD1*
  - *Ferritin (Fer1)*
  - *Dehydrin- AmDHN*
  - *Stress tolerant- Am244*
  - *Phytosulfokine peptide precursor*
  - *Ascorbate peroxidase- Am-pAPX1*
  - *Monodehydroascorbate reductase –MDAR*
  - *NAC transcription factor (AmNAC1)*



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- Abiotic stress tolerant Na.sup.+ / H.sup.+ antiporter gene (PcNHX1) from *Porteresia coarctata* along with the promoter region for conferring salt or drought tolerance in plants.
- Glutathione-S transferase gene (PjGST) from *Prosopis juliflora* cloned in suitable plant transformation vector (pCAMBIA 1301) under the control of CaMV 35S promoter and poly adenylation sequences.
- Method for producing abiotic stress tolerant ie. salt and drought resistant transgenic plants by expressing the said genes
- Transformation with the said genes to confer salt and drought tolerance is possible both in monocotyledons and dicotyledons plant system.
- Single copy insertion with Agrobacterium mediated transformation is available for the said genes.
- The transgenic plants withstood salinity stress of 300 mM of NaCl and drought condition for a period of eight days.
- Transgenic plants showed increase in the yield.
- Transgenic pure lines and gene constructs for the said genes are available.

### **Validation**

- ❖ Field trials for transgenic pure lines of indica rice varieties like IR64, IR 20, Pooni, ADT43 transformed with superoxide dismutase (AmSOD1), Ferritin (Fer1), Am244 has been conducted. The plants were watered every 8<sup>th</sup> day and withstood NaCl concentration of 300mM. The transgenic plants showed 40% increase in the yield.
- ❖ Field trials for transgenic pure lines of tobacco transformed with dehydrin (AmDHN) have been conducted.



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- ❖ Field trials have been conducted with the gene constructs of the antiporter gene (PcNHX1) along with the promoter and NAC transcription factor (AmNAC1) for tobacco and Arabidopsis.

### **Product Forms**

- Transgenic pure lines transformed with superoxide dismutase-AmSOD1 and Ferritin (Fer1)
- Transgenic pure lines in advanced stage of development transformed with
  - *Dehydrin- AmDHN*
  - *Stress tolerant- Am244*
  - Phytosulfokine peptide precursor
  - Ascorbate peroxidase-APX
  - Monodehydroascorbate reductase –MDAR
  - Phytosulfokine peptide precursor
- Gene constructs for
  - Superoxide dismutase- AmSOD1
  - Ferritin-Fer1
  - *Dehydrin- AmDHN*
  - *Stress tolerant- Am244*
  - Glutathione-S transferase (PjGST)
  - Ascorbate peroxidase-APX
  - Monodehydroascorbate reductase –MDAR
  - NAC transcription factor (AmNAC1)
  - Na.sup.+/H.sup.+ antiporter(PcNHX1)



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### **Patents**

- The technology for Dehydrin Gene From *Avicennia Marina* Responsible For Conferring Salt Tolerance in Plants is patented: **U.S. patent No. 7,622,636** issued November 24, 2009
- The technology for Glutathione-S-transferase gene From *Propolis juliflora* responsible for conferring abiotic stress tolerance in plants is patented: **U.S. patent No. 7,655,837** issued on February 2, 2010 “Glutathione-S-transferase gene from *Propolis juliflora* confers abiotic stress tolerance in plants”.
- The technology is patent pending:  
PCT patent application (**WO/2007/029270/ US20090313726**) was filed on September 7, 2006;  
PCT patent application (**WO/2007/015268 / US 20090210969**) was filed on July 31, 2006  
Indian patent application (**1015/CHE/2005**) was filed on July 27,2005;  
Indian patent application (**1051/CHE/2005**) was filed on August 3, 2005

### **Publications**

- S R Prashanth, V Sadhasivam, Ajay Parida. Over expression of cytosolic copper/zinc superoxide dismutase from a mangrove plant *Avicennia marina* in indica rice var Pusa Basmati-1 confers abiotic stress tolerance. *Transgenic research*. 2008 Apr;17(2): 281-91
- Mehta Preeti A.; Rebala Keerthi C.; Venkataraman Gayatri; Parida Ajay. A diurnally regulated dehydrin from *Avicennia marina* that shows nucleo-



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- Kumaresan Kavitha, Gayatri Venkataraman, Ajay Parida. An oxidative and salinity stress induced peroxisomal ascorbate peroxidase from *Avicennia marina*: Molecular and functional characterization. *Plant Physiology and Biochemistry*, 46, 8-9, 2008, 794-804
- G. Ganesan, H.M. Sankararamasubramanian, Jithesh M. Narayanan, K.R. Sivaprakash, Ajay Parida. Transcript level characterization of a cDNA encoding stress regulated NAC transcription factor in the mangrove plant *Avicennia marina*. *Plant Physiology and Biochemistry*, 46, 10, 2008, 928-934