FACULTY OF LIFE SCIENCES AND BIOTECHNOLOGY

SOUTH ASIAN UNIVERSITY

GUEST LECTURE SERIES

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Speaker: **PROF. BAISHNAB C. TRIPATHY**, FNA, FNASc, FNAAS
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Title of the talk: **Genetic Manipulation of Plants to Minimize Oxidative Stress and Enhance Photosynthesis and Plant Productivity**

Abstract: *Arabidopsis thaliana* protochlorophyllide oxidoreductase C gene (*porC*), involved in chlorophyll biosynthesis, was used to genetically transform rape seed oil crop Indian mustard (*Brassica juncea*) under the control of 35S promoter. Transgenic plants accumulated higher chlorophyll than their wild types. The 5-aminolevulinic acid (ALA), a precursor of chlorophylls, was used as a photodynamic herbicide. The latter when sprayed at sunset induced plants to accumulate excess protochlorophyllide (Pchlide). In the morning when the Sunlight fell on the plants, most of Pchlide due to limitation of POR are not photo-transformed to Chlide and acted as the photosensitizer. Non-photo- transformed Pchlide generated singlet oxygen that killed the plants. When ALA was sprayed on wild type and transgenic plants the latter very efficiently converted the photosensitizer Pchlide to Chlide due to over-expressed PORC. Therefore, the transgenic plants had only marginal damage due to the herbicide ALA whereas wild type plants died in response to ALA treatment. *PORCx Brassica juncea* plants had higher photosynthetic rate due to increased Chl content and were resistant salt-induced oxidative stress induced by salinity.
During Chlorophyll degradation Chlorophyll a is hydrolyzed in to pheophorbide a or chlorophyllide a and free phytol. However, phytol produced during chlorophyll degradation is usually recycled for chlorophyll resynthesis utilizing nascently synthesized chlorophyllide. The phytol before being esterified with chlorophyllide is phosphorylated by phytol kinase (VTE5) to phytyl phosphate. The phytyldiphosphate, could be either metabolized to synthesize Chl or could be converted to tocopherol by homogentisate phytyltransferase. The tocopherols are efficient quenchers of $^1O_2$. As tocopherols are highly hydrophobic they are located in the membrane bilayer and protect the biomembranes from $^1O_2$ -induced injury. Genetic manipulation of chlorophyll and tocopherol biosynthesis in *Brassica* via overexpression of Phytol kinase (VTE5) augmented the chlorophyll and tocopherol (vitamin E) synthesis. It resulted in higher accumulation of chlorophyll and tocopherol in leaves and seeds of transgenic mustard. Increased chlorophyll synthesis coupled with efficient quenching of 1 O 2 by tocopherol led to increased photosynthesis, plant productivity and grain yield in normal growth conditions as well as in a salinity-induced stressful environment.

About the Speaker: Prof. Baishnab Tripathy is a Professor, J C Bose National Fellow in the School of Life Sciences, Jawaharlal Nehru University, New Delhi. He had served as the vice-chancellor of Ravenshaw University, Cuttack, and as Dean (acting) of the School of Life Sciences at JNU. He is a Fellow of the National Academy of Sciences, INSA, and the National Academy of Agricultural Sciences and served as Co-Principal Scientist in the PESTO NASA Space Biology Program. His area of research lies in plant growth under varied conditions such as zero gravity, high CO_2, various light qualities and heavy metals. He is also the President of Kalinga Sikhya Samaj, Delhi, devoted to spreading value-based education among masses.