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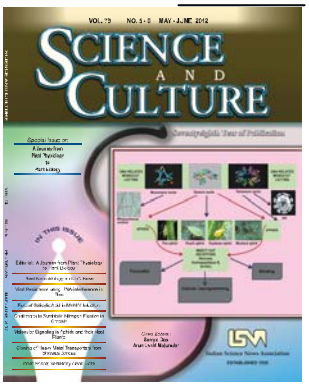
EDITORIAL

A JOURNEY FROM PLANT PHYSIOLOGY TO PLANT BIOLOGY



The idea behind the theme " A Journey from Plant Physiology to Plant Biology" was to assess recent developments in plant science research from the traditional plant physiology towards understanding the molecular mechanisms of the plant physiological processes leading to a new discipline of Plant Biology. With the availability of complete genome sequences of a large number of plant species from lower to higher groups, and advent of genomics, proteomics, computational biology and the more recent associated technologies, it has now become possible to probe into the plant physiological processes more in terms of molecular interactions among the individual genes and proteins along with their regulatory counterparts. More recently, unraveling the mysteries of physiological processes in this manner gave birth to a newer discipline of Plant Systems Biology. In the present scenario when population strength has gone up to unexpected height, food security in terms of both availability and nutrition has become an issue of global importance and as a result major price hikes of staple food crops have occurred in recent years. An accurate set of information towards understanding of plant processes ultimately lead to desired manipulations in which plant biotechnology research takes a major role in formulating strategies to feed the whole world at a time when prevailing adversities and impeding global climatic change threatens the human society.

Keeping such transition in mind, an International symposium on "A Journey from Plant Physiology to Plant Biology " was organized by Bose Institute during November 24- 28, 2008 in collaboration with the Plant Physiology Forum, Kolkata while commemorating the 150th Birth Anniversary of Acharya J C Bose and the Birth Centenary of Prof S.M.Sircar, a noted Plant Physiologist and one of the former Directors of Bose Institute. The deliberations included those by a number of established scientists from both India and abroad (for complete list of speakers see page 194). In addition, to commemorate Prof Sircar's birth centenary, Dr Pratip Palit conducted a session devoted entirely to reminiscence of Prof Sircar where a large number of his

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former students and associates gathered to pay homage to the great soul.

In the present special issue of *Science and Culture*, we have selected out few presentations made during the symposium and solicited updated articles based on the theme of discussions thereof. One of them by Virginia Shepherd titled "At the roots of Plant Neurobiology : A brief history of the biophysical research of J.C.Bose" discusses the topic of mechanosensory reception in plants, originally promulgated by Acharya J C Bose, wherein the idea of unified response mechanism of animal and plants to environment was rooted. This had remained an extremely important albeit marginalized area of interdisciplinary research and currently of limited interest (most unfortunately!) to modern day plant biologists. From a historical perspective, Shepherd analyzed the development of the concept culminating in the establishment of the new discipline of Plant Neurobiology. Let us hope that this article would incite the younger generation of plant biologists to take up this promising yet unexplored area originated from Bose Institute itself.

While Shepherd discusses crossing the boundary of plant and animal in terms of responses to external stimuli, E C Cocking in his article "From Plant Protoplasts to Diazoplasts : The challenge of establishing symbiotic nitrogen fixation in cereals" establishes crossing similar barrier by the nitrogen-fixing bacteria from the known leguminous plants to cereals in terms of biological nitrogen fixation. Establishment of an adequate level of intracellular bacterial colonization and effective nitrogen fixation with or without nodulation remains as a challenge to plant scientists despite the fact that from the point of view of energy balance, fixation of molecular nitrogen poses no evolutionary constraints among plants. "Diazoplasts", a hypothetical organelle analogous to a chloroplast, acquired by an endosymbiotic prokaryote into the plant's genome could make such a phenomenon possible. *Gluconacetobacter diazotrophicus*, a bacterium capable of fixing nitrogen by itself and colonized in symbiosome-like compartments in the meristematic root cells of cereals and other non-legume crop, seems to be the ideal organism for such phenomenon.

Abiological agents such as heavy metals which invariably come in contact with plants are capable of influencing the functioning of plants in a similar fashion. Such an aspect has been discussed by Das *et al* who have put forward evidence that metal chelators have the potential for cleaning up the environment through their interaction with plants. A number of genes for such metal transporters have been detected in metal accumulating plants by employing modern technologies.

Through the tremendous advancement in functional plant biology research in the recent past, it is realized that like abiotic influences such as light, UV, drought, temperature , heavy metals etc, plants also can perceive signals from biotic factors. This stimulated scientists to undertake investigations on the recognition capacity of plant immune system in a broader perspective and concurrent studies on pathogen biology. Amongst such biotic factors, viruses are the only pathogenic agents which operate within the plant cell by hijacking the host cell machinery. Plant viruses usually have small genomes which code for only a few proteins, but are able to successfully induce rapid biochemical changes within the cell culminating in the disease. Understanding the strategy used by viruses in producing a disease has been discussed by Tyagi *et al* who developed strategies to modulate the host plant by involving the small interfering RNA (RNAi) technology to interrupt vital functional machinery of viruses inside the plant leading to viral resistance.

Food security is often threatened by loss of crop productivity due to the impact of plant diseases as a consequence of emergence of newer pathotypes. This has sparked an increased focus of research on improving approaches to crop protection. Co-evolution of both plants and pathogens have been taking place and one always looks for opportunities to overpower the other the resultant impact being either disease susceptibility or resistance. Kundu *et al* have taken approach to re-establish that Salicylic acid (SA), a well known plant growth regulator has definite role in defense mechanisms against biotic and abiotic stresses. Proteomic analysis of SA treated plants revealed that pathogen infested plants often exhibit enhanced production of primary metabolites for the secondary metabolic pathways without compromising the growth and development. Gupta and Das relied on plant derived carbohydrate binding proteins fairly known as lectins, engineering them in host plants and allowing them to bind to the respective carbohydrate residues of cellular components of the host plant invading insect pests and pathogens to destabilise the normal functionality of the particular class of pathogens thus, leading to plant protection.

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Sampa Das
Arun Lahiri Majumder

Sampa Das obtained her Ph.D degree (1981) working under the supervision of Prof S K Sen of Bose Institute and later joined the Faculty. Her major interest is in understanding of various mechanisms of plant defense responses against pests and pathogens with an aim to combat the stress. She has extensive National and International research collaboration in this area. She is a Fellow of the Indian National Science Academy (FNA) and The National Academy of Sciences, India (FNASc). Currently she is a Senior Professor and Head of the Division of Plant Biology, Bose Institute.

Arun Lahiri Majumder obtained his Ph.D in Botany (1973) working under the supervision of Prof B B Biswas of Bose Institute and a D.Sc in Biochemistry (1982) from the Calcutta University. Following the post-doctoral work at the National Institutes of Health (1973-77), he served as a Faculty in the School of Life Sciences at Visva Bharati University and joined Bose Institute in 1991. His major interest throughout had been biochemical and genetic regulation of inositol metabolism particularly in relation to abiotic stress in plants. He is a Fellow of the Indian National Science Academy (FNA), Indian Academy of Sciences (FASc) and The National Academy of Sciences, India (FNASc) and has several national awards to his credit. A former Senior Professor and Head of the Division of Plant Biology, Bose Institute, he is currently attached to the Division of Plant Biology, Bose Institute as a Raja Ramanna Fellow (DAE).

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