

Delhi) set the stage for a panel discussion by sharing some statistics on the status of women in science in India and France respectively.

CNRS, the largest public basic research organization in Europe, has more than 33,000 employees, with 20 Nobel laureates, 12 Field Medal laureates, and one Turing Award laureate. Out of 25,000 permanent staff 42.6% are women, a 0.4% rise since 1999. Internal assessments have revealed that most male scientists reach managerial positions by the age of 40, which is not the case with women. Since 1954, only three Gold Medals have been given to women; Gold Medal is the highest honour for a scientist in France. However, things are slowly changing with new initiatives like 'The Mission for the Place of Women at CNRS' and the European INTEGER (Institutional Transformation for Effecting Gender Equality in Research) project.

While Pepin's presentation was filled with data and specific measures from the French Government, Bal presented the scarce data available in the Indian context, and spoke about lack of action taken by the Indian Government on the recommendations of the DST Task Force for Women in Science. The data show how women are under-represented in science in India. For example, less than 10% of IISc faculty are women; less than 25% of those who appear for the Joint Entrance Examination for IITs are girls, and out of 461 Bhatnagar Awards that have been given, only 15 have gone to women. The importance of obtaining precise statistics on the Indian situation was agreed upon by all participants.

Rohini Godbole and Jenifer Clark moderated the discussions. The audience of about 230 people also participated actively in the discussions. Women from the audience called for a more flexible

institutional and government structure for women scientists, training on alternate careers, better child-care facilities at workplaces, increasing Indo-French cooperation involving women researchers (cooperating also with male researchers), more transparency in the procedures to deal with sexual harassment in science, providing childcare facilities during scientific conferences so that women can participate, as well as the importance of having around 30% women in scientific evaluation committee, especially in those of the CEFIPRA, among other things.

Jenifer Clark, Embassy of France in India – Bengaluru, France; **Rohini Madhusudan Godbole***, Centre for High Energy Physics, Indian Institute of Science, Bangalore 560 012, India and **Madhukara Putty**, Gubbi Labs, LLP, Gubbi 572 216, India.

*e-mail: rohini@cts.iisc.ernet.in

MEETING REPORT

Plant science research*

Plant sciences have flourished enormously with more precise achievements during the last several decades and many new potential areas have been identified. Growing concern on food security and biodiversity conservation coupled with the advent of molecular biology has renewed our interest and opened up new horizons furthering our understanding of plant life. Despite this, the progression in plant science research is still facing a number of challenges and has vast opportunities with many new dimensions yet to be explored. A national symposium held recently aimed to stress upon future research in this core domain of biological sciences. The symposium was attended by over 150 delegates and eminent scholars across all disciplines of plant sciences from almost all parts of the country. The event took stock of current developments and scientific innovations in existing and emerging areas together with the present and future challenges in plant sciences. The main idea

of the symposium was to deliberate on plant science research to make it more meaningful to the environment and society. The deliberation spanned several important domains such as how potentially the future plant science research can be applied in human welfare, especially food security, nutraceuticals, renewable energy, climate change, biodiversity conservation and other ecosystem services.

The symposium was inaugurated by Gautam Kalloo (Jawaharlal Nehru Krishi Vishwavidyalaya, Jabalpur). The inaugural session was followed by a series of technical sessions which included 12 invited lectures by eminent scientists. These were held in parallel with poster presentations by scientists and scholars. Kalloo emphasized on the significance of plant science research for attaining global food security. He strongly advocated that broadening of genetic base, germplasm utilization and molecular breeding can result in a future strategy ensuring food for all. Other demanding tasks like soil fertility erosion, stress resistance and constraints in organic farming faced by Indian farmers were emphasized. Enhancing the organic farming for horticultural crops would be a potential approach, both in terms of quantity and

quality of produce and for maintenance of horticultural ecosystems. The need for re-orienting plant science research and implementation strategies to suit decision-makers to ensure safe and sufficient food for all, and concern for inclusive bio-based economic development to reduce inequality between farming and non-farming sectors were explained in detail. Innovative research needs to be coupled with an institutionalized mechanism that could help farmers to understand our research and developmental pursuits and resolution of discontent among them. This has relevance due to the fact that an increase of 1% of GDP from agricultural sector can increase the purchasing capacity in the poorest deciles by more than 2.5-fold to the rest of the economy. Despite this merit, the share of agriculture in GDP continues to decline. Thus, strengthening agriculture-oriented research in plant sciences would contribute to reducing both poverty and inequality in the society.

A. K. Tripathi (Central Institute of Medicinal and Aromatic Plants, Lucknow) stressed upon the significance of *Azospirillum*, a phyto-stimulator (root promoter) in non-leguminous crops. He uncovered the fact that a translational coupling between sigma and anti-sigma

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factors determines the course of carotenoid production to induce tolerance to abiotic stresses in *Azospirillum* sp. This provided evidence of a crosstalk between sigma and anti-sigma as a strategy for recovery from oxidative stresses. Manoj Majee (National Institute of Plant Genome Research, New Delhi) emphasized the importance of an enzyme L-isoaspartyl methyltransferase (PIMT), a low molecular weight protein, regulating seed viability. He elaborated on various properties of this protein and disclosed a secret of PIMT regulating viability, longevity, metabolic repair, and seed dormancy, and reiterated its significance in chickpea.

A. K. Jukanti (Central Arid Zone Research Institute, Jodhpur) addressed the significance of molecular studies in crop improvement to cope with adversities of climatic extremes. Increasing global temperature and shifting rainfall patterns invite an opportunity for the development of 'smart' crop varieties to ensure food security. Elaborating his observations on wheat, barley, pearl millet and chickpea, Jukanti advocated the need to establish synergy between traditional and advanced molecular breeding approaches to enrich the grain protein content (GPC) through early leaf senescence and nitrogen re-mobilization by identifying sink- and source-related candidate genes important for GPC and leaf senescence. He also stressed on the importance of polyphenol oxidase (PPO) gene family associated with wheat, a major wheat kernel PPO of 58 kDa (CA716843) that may help enhance the water stress proteins. D. Fernando (University of Manitoba, Canada) delivered a talk on phyllosphere-microbes interactions. He explained how the host-pathogen interaction of phyllosphere microflora can potentially be exploited for crop sustainability. He also presented the results of application of bio-control protocol to samples of phyllosphere microbes and elucidated a tripartite interaction among host, pathogen and a beneficial microorganism.

Brijesh Kumar (Central Drug Research Institute, Lucknow) highlighted the significance of chemical fingerprinting in relation to authentication and quality control of natural products, particularly those of functional food and nutraceuticals. He stressed that using direct analysis in real-time mass spectrometry (DART-MS) chemical fingerprinting can help in simultaneously identifying multiple chemical markers and precise identi-

fication of bioactive compounds useful in herbal medicine and nutraceutical industries in a short time. D. K. Upreti (National Botanical Research Institute (NBRI), Lucknow) pointed out the emerging trends and challenges in lichenological research towards human welfare. He emphasized the significance of lichens in food, drug and dye industries. Multidisciplinary nature of lichenological research is attracting scientists from different disciplines such as pharmacology, biotechnology, plant and chemical sciences, to adopt synergy for identification, isolation and purification of bioactive molecules from lichens and to explore the possibility for human welfare.

Considering an example of *Arabidopsis*, Yogesh Mishra (Punjab University, Chandigarh) presented work on characterization of transcription regulatory targets of certain protein kinases in stress signalling in crop plants. Snf1-related protein kinase (SnRK1), with a catalytic alpha, a substrate targeting beta and a sensory activating gamma subunit, is a key regulator of plant response to biotic and abiotic stresses. He observed that conditional silencing of nuclear SnRK1 activating subunits in *Arabidopsis* altered the transcription of over 5000 genes involved in stress and hormone signalling pathways.

M. R. Suseela (NBRI), in her talk on 'Advantages of algal biofuels over crop plants', invited global attention towards algal biofuels as a renewable and alternative source of energy. She critically analysed the advantages of algal biofuels over those of higher plants. Algal organisms, a potential source of third-generation biofuel, due to their salient attributes, such as short generation time, high production of lipids, wide range of genetic diversity, easy control of gene manipulation, small area requirement for production scale-up, multiple usages including food, feed, nutraceuticals and adaptability to diverse environmental conditions, offer superiority over higher plants. She stressed on the need for reorienting our research focus on microalgae for biofuel production and human welfare.

H. N. Pandey (North Eastern Hill University, Shillong) in his talk on 'An ecological analysis of impact of human activities in Nokrek Biosphere Reserve of Meghalaya' observed that human activities and climate change-driven extreme events could be more devastating in mountainous regions, which are highly susceptible to topographical hazards. He

mentioned that the Nokrek Biosphere Reserve, which is structurally weak and fragile, is vulnerable to such events. He also elaborated on the management plans and restoration approaches which can enhance the habitat-linked niche partitioning in ecosystem recovery through promotion of species diversity in this Reserve. The necessity to evolve a holistic approach combining environmental, social and economic interests in a more balanced and sustainable manner was underlined during the discussions.

Tariq Hussain (NBRI) presented a glimpse of climate change-related shifts in floristic diversity of the Indian Himalaya. Credited as one of the top eight hotspots of biodiversity, the region harbours 8000 species of angiosperms, of which over 40% is endemic. Factors such as climate change, habitat loss, urbanization and invasion of alien species are adversely affecting the fragile ecosystems of the region and are a serious threat to the rich biodiversity of the Himalaya. According to the Red Data Book records, about 214 species of flowering plants in the Himalayan region are endangered, among which 29 species are critically endangered and need stringent steps for conservation. Although the role of different stakeholders and approaches of conservation need to be verified through case studies, measures to minimize anthropogenic pressure and reorient scientific investigations to understand the life-cycle strategies, range of geographic distribution and possible use of *ex situ* technologies may help in the conservation of these resources.

Based on the scientific deliberations and panel discussions, the core issues that emerged which need to be strengthened include: (a) manipulation of crops to improve yield quality and quantity to ensure food security; (b) approaches to strengthen biofuel-based renewable energy production; (c) biodiversity conservation, and (d) plant stress alleviation through microbial management.

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R. N. Kharwar, S. K. Dubey, J. Pandey and L. C. Rai*, Centre of Advanced Study in Botany, Banaras Hindu University, Varanasi 221 005, India.

*e-mail: lcrbhu15@gmail.com