

(~0.14 mW/mm<sup>3</sup>) and conversion efficiency of 4.7% with liquefied petroleum gas as the fuel. The compactness and high output power with significantly improved conversion efficiency appear to have the potential for portable micro-scale power generators for remote stand-alone applications.

One of the important conclusions of the final discussion was that future meetings

could be on a theme basis and should focus on the current problems in research and development to make the students aware of the on-going research areas.

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## MEETING REPORT

### Biodiversity Congress\*

The 2018 International Biodiversity Congress (IBC 2018) focused on the theme 'Biodiversity for ecological civilization' through the philosophy of 'Vasudhaiva Kutumbakam'. Over 800 delegates from India and abroad attended the event. The congress was inaugurated by the Chief Minister of Sikkim, Pawan Kumar Chamling, who stressed the need for protecting the Himalayan biodiversity hotspots and suggested an organic India mission by 2050. The event hosted six plenary, ten technical and three poster sessions under six themes. In total, 27 invited plenary lectures were delivered by eminent scholars and 92 papers were presented by the delegates.

In the inaugural session, Savita (Forest Research Institute (FRI), Dehradun) highlighted the importance of biodiversity for sustainable development and emphasized educating people for biodiversity conservation. Vandana Shiva (Founder 'Navdanya', Dehradun) focused on women empowerment and its role in sustainable biodiversity utilization, and underlined the Indian philosophy of 'Aranya Sanskriti'. Rakesh Shah (Uttarakhand Biodiversity Board (UBB), Dehradun) spoke on the transboundary issues and suggested minimizing unmindful developmental activities. Talking about ecological knowledge, functioning of biodiversity, and the impact of climate change on the distribution of species, S.

C. Gairola (Indian Council of Forestry Research and Education (ICFRE), Dehradun) shared the efforts of the council for biodiversity conservation and release of REDD+ strategy by the Ministry of Environment, Forest & Climate Change, Government of India (GoI), New Delhi. In a broadcasted inaugural message, Suresh Prabhu, Minister of Commerce, Industry & Civil Aviation, GoI, New Delhi emphasized the role of ocean biodiversity for the storage of carbon and food security. Shyam Saran (Prime Minister's Special Envoy for Nuclear Affairs and Climate Change, GoI, New Delhi) highlighted the lethal implications of unsustainable developmental paradigms and the need for following Mahatma Gandhi's philosophy on judicious utilization of natural resources. The Guest of Honour, Harak Singh Rawat, Minister for Forest and Wildlife, Government of Uttarakhand, Dehradun talked about the deep-rooted culture and tradition of the state in conserving and maintaining biodiversity.

In the first plenary session; while delivering the 'Indian perspective on biodiversity crisis', V. B. Mathur (Wildlife Institute of India (WII), Dehradun) mentioned that out of 52,017 faunal species assessed so far, 17,926 species are threatened. The Gangetic dolphin, dugong, the great Indian bustard and the Manipur deer are on the verge of extinction and therefore need conservation. Highlighting the 'trusteeship' concept of Mahatma Gandhi during his talk on 'Biodiversity education to address sixth mass extinction', Kartikeya Sarabhai (Centre for Environment Education, Ahmedabad) said that a range of eco-friendly practices are promoting more sustainable lifestyles, and therefore their replication could play a key role in biodiversity conservation. Highlighting the ancient traditions and

practices of India during his talk on 'Biodiversity – what will persist for future?', K. Venkataraman (formerly at Zoological Survey of India, Kolkata) presented the conservation challenges being faced by agrobiodiversity. Jyotsna Sitling (Ministry of Skill Development and Entrepreneurship, GoI) stressed upon developing skilled human resources to meet the challenges for nature conservation and mentioned the need for upskilling of professionals.

Sharing the pertinent points in 'Convention on Biological Diversity (CBD), Biological Diversity Act (BDA, 2002) and Nagoya Protocol', Rakesh Shah (UBB) highlighted the importance of prior informed consent (PIC) and mutually agreed terms (MAT) for benefit-sharing. Sanjay Molur's (Zoo Outreach Organization, Coimbatore) talk entitled 'Species are in crisis' discussed the conservation strategies to protect 'freshwater conservation points' of different threatened taxa. Balakrishna Pisupati (formerly at National Biodiversity Authority, Chennai) highlighted the importance of brand ambassadors for popularizing biodiversity crisis. M. K. Ramesh (National Law School, Bengaluru) suggested refinement in BDA, which is one of the best Biodiversity Acts globally. On the theme 'Biodiversity, bio-piracy, and intellectual property rights', Vandana Shiva spoke on 'Biopiracy, biodiversity, WTO and corporate control of biodiversity' and shared several success stories with special reference to 'neem biopiracy'. Delivering her talk on 'The Kilita, the cotton, and the Kani – why we need Courts', Prabha Sridevan (Former Chair-person of the Intellectual Property Appellate Tribunal) showed concern on mindless development and its consequences 'Aranyani Hantate', and underlined the need for sensitizing people about traditional

\*A report on the International Biodiversity Congress (IBC 2018) organized as a joint initiative of Centre for Innovation in Science and Social Action, Navdanya, Forest Research Institute (FRI), Indian Council of Forestry Research and Education, Wildlife Institute of India, Uttarakhand Biodiversity Board and Uttarakhand Council for Science and Technology and held at FRI, Dehradun from 4 to 6 October 2018.

knowledge, plant varieties and protection of farmers' rights. Highlighting the issues of conservation, sustainable use and access to benefit sharing, Biswajit Dhar (Jawaharlal Nehru University, New Delhi) spoke on the evolution of international regime.

Day 2 included plenary session III on the theme 'Mountains, ecosystem services and sustainability of fragile mountain ecosystems'. Arguing that market does not transfer money from consumers to ecosystem services producing regions, S. P. Singh (formerly at HNB Garhwal University, Srinagar Garhwal) stressed upon incorporating the Himalayan ecosystem services in national accounting. Dilsher Virk showcased glimpses from the book *The Legacy of the Historic FRI Building & Friends of the Doon*. Talking on 'Conservation challenges and Gadgil Report in the context of climate change' from the Western Ghats perspectives, V. S. Vijayan (Salim Ali Foundation, Thrissur, Kerala State Biodiversity Board) underlined the need for ecological civilizations. Presenting glimpses of the National Mission on Himalayan Studies, R. S. Rawal (G.B. Pant National Institute of Himalayan Environment and Sustainable Development, Almora) highlighted R&D interventions for strengthening the mountain ecosystems. With special reference to the diversity of Leh and Ladakh region, Om Prakash Chaurasia (Defence Institute of High-Altitude Research, Leh-Ladakh) talked on 'Trans-Himalayan plant biodiversity and its sustainable utilization and conservation'. R. D. Gaur (HNB Garhwal University) emphasized the Himalaya as the water reservoir of South Asian countries.

The fourth plenary session on the theme 'Biodiversity for food, nutrition and health' was chaired by Vandana Shiva. She emphasized the principle of resilience, social and cultural values, nutrition and health governed by the natural resources in remote areas, while sensitizing 'gross happiness index' of Bhutan. Renate Kunast (Germany) advocated adoption of international protocols and agreement to protect biodiversity, and to break the dependency and monopoly of multinational companies. Speaking on 'Biodiversity and public health', Mira Shiva (Initiative for Health Equity and Society, New Delhi) raised concerns over transgenics and horizontal gene transfer. Debjani Roy (Quality Council of India, New Delhi) elaborated about the 'Voluntary Certification Scheme for

Traditional Community Healthcare Providers (VCSTCHP)'.

Focusing on the worldviews of education models, the final day was chaired by Savita on the theme 'Biodiversity and knowledge systems'. James Buchanan (Xavier University, USA) delivered a talk on 'Teaching complex systems: reshaping education to reshape civilization'. Deepak Apte (Bombay Natural History Society, Mumbai) described implications of increasing frequency of elevated sea surface temperature (SST). Erach Bharucha (Bharathi Vidyapeeth, Pune) discussed the importance of biodiversity in formal education, while Bittu Sehgal (*Sanctuary Magazine*, Mumbai) emphasized the importance of youth in spearheading biodiversity conservation. Delivering his talk on science, policy and public engagement for biodiversity conservation, Ravindra Singh (Indo-German Biodiversity Program, GIZ) mentioned that scientists, policy-makers, and media are the three key players in prioritizing and implementing solutions for conservation challenges.

The sixth plenary session on the theme 'Biodiversity, climate change and planetary health' was chaired by K. Venkataraman (Zoological Survey of India). Emphasizing on 'Food is medicine and medicines are food – Ayurveda dictums', G. G. Gangadharan (Ramaiah Indic Specialty Ayurveda Restoration Hospital) highlighted the importance of good food habits. Focusing on wildlife conservation in an uncertain climate future, Sejal Worah (WWF-India, New Delhi) mentioned that the climate-sensitive species are required to be mitigated and regulated. A. Biju Kumar (University of Kerala) emphasized climate change education to achieve the objectives of the United Nations (UN) Sustainable Development Goals (SDGs).

The interest in biodiversity conservation among children was also inculcated through 'Children's Biodiversity Summit' organized at the Hari Singh Auditorium, Indira Gandhi National Forest Academy (IGNFA, Dehradun). During the valedictory session 'Towards eco-civilization Vasudhaiva Kutumbakam', Vandana Shiva appealed to learn from nature and shed all junk. Gangadharan echoed the Doon Valley Biodiversity Pledge, i.e. 'Biodiversity for Ecological Civilizations'. Sharing glimpses of his book series *Bahuda*, B. P. Singh (Former Governor, Sikkim, and Former Secretary Environment, in whose tenure the BDA 2002

was drafted) spoke on building an ecological civilization to remain associated with the Indian concept of 'unity in diversity'.

The Chief Guest Trivendra Singh Rawat (Chief Minister, Uttarakhand) highlighted the rich heritage and biodiversity of Uttarakhand, which attract tourists, philosophers, scientists and saints. He appreciated the appeal of Chamling for launching an organic Himalaya and promised to extend all possible assistance to move forward in this direction. Ensuring the deep concerns over challenges being faced by India, he emphasized combining the best of traditional wisdom and science with stakeholder participation in a whole-system perspective. Vinod Kumar Bhatt (Navdanya) proposed the vote of thanks. The major recommendations of IBC 2018 are listed below:

- Launching of new networks, and alliances at national and international platforms to promote the philosophy of 'Vasudhaiva Kutumbakam'.
- Leaders from science, media and politics should serve as ambassadors for ecological civilization at global level.
- Transboundary issues should be called upon by the nations to adopt biodiversity control measures.
- Necessary policies may be adapted to establish a legal and policy framework that facilitates green, low-carbon economy, promotes afforestation, strengthens wetland conservation and restoration, and promotes organic, nutrition-rich farming practices.
- Himalayan Ecosystem Services should be incorporated into national accounting. Developmental models like Sikkim should be replicated to ensure a healthier, cleaner and greener world.
- Nations should have sovereign rights on the biological resources which fall under their jurisdiction and the benefits arising from commercial utilization of biological resources must be shared with the local community. For its effective implementation, PIC is mandatory and MAT must be done with the local community.
- Transparent and fair labeling of food, agricultural products and other value-added products from biodiversity to prevent their misuse.
- Dialogue among relevant stakeholders should be encouraged to facilitate shift towards an ecological civilization that values, cherishes and conserves biodiversity.

- Women must be empowered to ensure their effective role in sustainable livelihood programmes for biodiversity conservation.

- Recognizing the role of ocean biodiversity in carbon storage, promoting blue economy, and food security, sincere efforts are required to increase the marine protected area network in India.

- Effective monitoring of SST and coral ecosystem restoration should be given priority.

- Understanding the patterns and processes of change to draw a realistic action agenda for conservation and sus-

tainable use of Himalayan goods and services.

- Multidisciplinary research programmes must be accelerated for strengthening the mountain ecosystems, which might be promoted in academic and research institutions to work towards Aichi Biodiversity Targets and UN SDGs.

- Coupled with environmental education, biodiversity education should be made compulsory in formal and non-formal system, by involving extensive use of Information and Communication Technology and linkages with media.

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## RESEARCH NEWS

### A rare occurrence of $2n$ gametes functioning in interspecific crosses involving commercial cultivar of sugarcane (Co 89029) and *Saccharum spontaneum* L.

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Functioning of  $n$  and  $2n$  gametes in sugarcane is a cytogenetic peculiarity with specific crosses involving different species and genera of the *Saccharum* complex. The  $2n + n$  transmission is predominant in crosses of *S. officinarum* and *S. spontaneum*, and this had earlier led to the success of the first evolved variety 'Co 205' in 1918. Exceptions of  $n + n$  gametes have also been reported later. However, transmission of  $2n$  gametes in the crosses involving commercial varieties and *S. spontaneum* is a rare occurrence. Transmission of  $n + n$  is the major limitation in prebreeding of sugarcane for introgression of *S. spontaneum* ( $2n = 40-128$ ) genome into commercial varieties as donor for incorporating pest and disease resistance, wider adaptability, high tillering, etc. The  $F_1$  progenies have to be backcrossed for several generations in varietal developmental programme<sup>1,2</sup>. Hence selection of hybrids with female restitution in wide crosses is highly advantageous in nobilization programme.

Chromosome transmission pattern in 39 hybrids of three crosses involving a commercial variety of sugarcane, Co 89029 ( $2n = 110$ ) (as female) and three different cytotypes of *S. spontaneum* ( $2n = 64, 88$  and  $112$ ) (as male) was analysed along with their parents through mitotic preparation from root-tip squash.

Among the three cytotypes,  $n + n$  contribution was strictly followed in  $2n = 64$

derived progenies with few aneuploids, whereas the derivatives of  $2n = 88$  and  $112$  exhibited both  $n + n$  and  $2n + n$  transmission. Among 18 clones of Co 89029 ( $2n = 110$ )  $\times$  *S. spontaneum* ( $2n = 88$ ) analysed, the hybrid (04-2163) showed  $2n = 153$  with  $2n + n$  transmission, whereas the expected number was  $2n = 99$  from  $n + n$  segregation. Seventeen hybrids of this cross possessed chromosome number  $2n = 85-99$ . Two clones were stable with expected chromosome number  $2n = 99$ . Elimination of chromosomes from 2 to 15 was noticed in 15 clones with a frequency of 83.3%. In the cross of Co 89029 and *S. spontaneum* ( $2n = 112$ ), the hybrid 04-244 possessed  $2n + n$  transmission with  $2n = 166$ , while the expected number of  $n + n$  transmission was  $2n = 111$ . Nine hybrids had elimination of 1-11 chromosomes and one hybrid (04-1879) exhibited the expected chromosome number of  $2n = 111$ . Kandasamy<sup>3</sup> observed differential chromosome transmission pattern in the crosses involving POJ 2725 and *S. spontaneum* with the cytotypes  $2n = 64$  and  $2n = 112$  with  $n + n$  and  $2n + n$  transmission respectively. He noted  $2n = 161$  in a hybrid with  $2n + n$  transmission from the cross of POJ 2725 and *S. spontaneum* ( $2n = 112$ ). The hybrid with  $2n = 166$  (04-244) in the present study is the highest record for chromosome number of interspecific crosses involving a commercial variety and *S. spontaneum*.

Despite their high ploidy level and chromosome number, the hybrids exhibited normal meiosis. Meiotic studies in 04-244 (Co 89029  $\times$  *S. spontaneum*,  $2n = 112$ ) revealed 82 bivalents and two univalents at metaphase I. In 04-2163 (Co 89029  $\times$  *S. spontaneum*,  $2n = 88$ ), 65-74 bivalents and 1-4 univalents were observed. Laggards were few and tetrads were either normal, or with 1-4 micronuclei. Molecular marker analysis with 35 SSR primer pairs confirmed the hybridity with the presence of female- and male-specific fragments.

Success of prebreeding and development of potential genetic stocks depend on the type of chromosome transmission in wide hybrids of sugarcane. This study has clearly indicated the advantages of exploitation of higher cytotypes of *S. spontaneum* to harness female restitution. Hence, more crosses with higher cytotypes will facilitate the progenies with  $2n$  female gametes.

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