carcinoid, neuroblastoma and painful bone metastases was discussed in detail.

There was a session on 'Detector demonstration'. Different detectors were demonstrated along with a poster explaining their working principle and applications. The following detectors were demonstrated under the leadership of S. Saha (SINP): thick GEM, superheated droplet detector, multi wire proportional counter (MWPC), Ge-crystal, dosimeter, scintillation detector, charged particle detector, photon multiplicity detector, plastic scintillator, muon detector and MANAS and track projection chamber.

The workshop ended with a panel discussion involving panelist from different fields: S. C. Roy (Science & Culture), G. Ganguly (University of Calcutta, Kolkata), B. K. Chatterjee (Bose Institute, Kolkata), S. Chattopadhyay (VECC), S. Basu Roy (Institute of Post Graduate Medical Education & Research/SSKM Hospital, Kolkata), and S. Chattopadhyay (SINP). The topic of the discussion was 'Enthusing experimental research – present problems and possible solutions'. The aim of this panel discussion was to make the experimental programme more interesting to students by explaining the importance of experimental work to the global scenario and to motivate them in experimental research.

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MEETING REPORT

Growing interest in doubled haploidy for improvement of horticultural crops in India*

Sexually producing diploid plants carrying a set of chromosomes from each parent are the rule in nature. For crop breeders, haploid plants represent a more useful resource. Though haploidy was first reported by Bergner in 1921, the first attempt to use it in breeding was done in 1952 by Chase in maize. Ever since, several techniques for induction of haploidy, including pollen irradiation prior to pollination, alien cytoplasm, ultra wide hybridization, inducer lines, micro/megaspore culture and more recently, the Cenh3 histone-based haploidy have been reported in several crops with varying success. Since such plants have only one version of each gene, they are of special interest for geneticists. Further, these plants can be used to develop doubled haploid (DH) populations which are of great value in crop improvement.

Incorporating DH in breeding programmes has the advantage of accelerating inbred line development by achieving homozygosity instantly within a generation. DH technique can be used to transfer sterile cytoplasm of CMS lines into a desirable background in a single step avoiding many generations of backcrossing. Further, DH can also be employed for studying inheritance of quantitative traits, QTL mapping, genomics, gene identification, as base material for Targeting Induced Local Lesions in Genomes (TILLING) populations, production of stable transgenic plants and reverse breeding. With these advantages, haploidy is emerging as a powerful tool to enhance genetic gain per cycle, which is of more relevance in horticultural crops that are either perennial in nature or outcrossing with inbreeding depression or with great commercial value where breeding duration is critical.

Recognizing the growing interest in this area, a one-day interactive meeting on 'Doubled haploids: scope and future in horticultural crops' was organized. Over 200 participants across the country representing various research institutions, state universities and private seed companies participated in the event chaired by N. K. Krishna Kumar (ICAR, New Delhi).

The programme included invited lectures by eminent scientists from CIMMYT, IISER-Trivandrum, UAS-Bengaluru, Monsanto, Syngenta, Namdhari Seeds and *In Vitro* International, who shared their experience in the field. Anand (Namdhari Seeds, Bengaluru) analysed the current status of expertise and achievements in India and the problems associated with this technology for vegetable crop improvement.

Unlike the gamete culture-based techniques that are commonly being used in horticultural crops, the technique of using haploid inducing lines in maize added a new dimension to the experience in horticultural crops. Karthikeya (CIMMYT Regional Station, Hyderabad) gave a brief account of the work on genotypes inducing haploids both in temperate and tropical backgrounds of maize at CIMMYT and its scope in other crops.

More recently, Cenh3 histone-based haploidy has been reported, which has the potential to replace all existing techniques of haploidy induction considering its recovery efficiency and handling ease. M. Ravi (IISER-Trivandrum), the inventor of this patented technique, presented the prospects of developing doubled haploids through centromere-mediated uniparental genome elimination in horticultural crops.

The meeting helped create awareness, deliberate and debate on strategies and prospects of using doubled haploidy in horticultural breeding programmes. It also brought to light that several vegetable seed companies like Monsanto, Syngenta, Nunhems (Now Bayer), Namdhari, HyVeg, etc. have already made significant progress in this regard, especially in crops like cauliflower, cucumber, pepper, melons, etc. while

*A report on the one-day interactive meeting on 'Doubled Haploids: Scope and Future in Horticultural Crops' held on 4 October 2013 at the Indian Institute of Horticultural Research, Bangalore, in association with the Society for the Promotion of Horticulture, Bangalore.

their common experience is that tomato does not respond to the existing techniques available. A DH service company, *In Vitro* International, Bengaluru with vast experience in DH of field crops like corn, mustard and canola, is planning DH in vegetable crops for the seed companies in a big way.

At the end of the programme, a session was dedicated to develop joint ventures to share and bring together the synergy of public research institutes and private sector breeding companies in this area. One such venture is the collaboration between the Indian Institute of Horticultural Research (IIHR) and AMRUTH SEEDS, Bengaluru based on a MOU during March 2014. The project aims at standardizing protocols and developing DH lines in cucumber, chillies, okra and watermelon, through cultured anthers/microspores. Another such venture in its infancy is the CGIAR-NARS partnership between CIMMYT and IIHR to set up a mega facility at Bengaluru based on a feasibility study done during May 2014. This facility is for high throughput induction and production of DH lines in corn and sweet corn employing haploid inducer lines and later to expand this experience to several horticultural crops.

A book titled *Doubled Haploids for Crop Improvement*, edited by Krishnamoorthy *et al*. is being published (ISBN: 978-93-5137-480-0) and will be released in June 2014. This book is a technical compilation based on the presentations and discussions held during the meeting. The book covers review articles on novel techniques of developing DH using Cenh3 histone-based haploidy, haploidy inducers, genetic and transgenic approaches for haploid production and haploids in vegetable crop improvement. Besides these, focus articles on the production of haploids in brassicas, solanaceous vegetables, melons, gourds, cucumbers and legumes are also covered.

Overall, there is a growing interest in haploidy for horticultural crop improvement in India and the prospects for utilization of this technology appear to be bright. The efficiency of DH recovery in various horticultural crops is expected to improve over the next few years to adopt this as a regular breeding technique.

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