In particular his engineering analysis of secondary flows and particle motion/ deformation are considered both innovative and pragmatically important.

Srinivasa Varadhan, Professor of Mathematics in the Courant Institute of Mathematics, New York University, is also among the newly elected members. Varadhan has been a central figure in the development of probability theory during the last thirty years. His work with Stroock on the Martingale formulation for Markov processes has changed fundamentally how they are viewed which has proved essential for the study of Markov processes with complex state spaces. In his recent work on hydrodynamic scaling he has since answered some of the difficult questions concerning the approach to equilibrium of large systems with slow modes.

Tree seed science and nursery technology in the conservation of forest genetic resources

The rapid rise in human population and their consequent increased demands for more and more utilization of natural resources have led to the rapid depletion of forest cover and a disturbance in the ecological balance. Conservation of biodiversity and more specifically forest genetic resources is, therefore, becoming increasingly important. Since seeds are the major components of such conservation programmes, it is not surprising that the focus of the annual meet of the 'International Union of Forest Research Organization' (IUFRO) held during 22–25 November 1997 was 'Innovations in Forest Tree Seed Science and Nursery Technology'.

The emphasis of conservation research today, is not only to select superior genotypes from amidst a population of highly variable cross-pollinated species but also to understand the reproductive biology of the concerned species. While a study of the seed development process is necessary to ascertain the right time of seed collection with respect to maturity, vigor and vitality, an understanding of the physiology and biochemistry of seeds helps in developing proper strategies for the storage of the three different types of seeds – 'orthodox', 'intermediate' and 'recalcitrant' and also in developing quality saplings.

The 'recalcitrant' seeds differ from the 'orthodox' ones in their (i) inability to retain viability below a critical level of inherent moisture and also (ii) in the absence of processes or mechanisms which confer protection against desiccation during processing. Thus, storage of recalcitrant seeds is extremely difficult.

Since recalcitrant seeds form the bulk of the plants, which comprise the tropical rain forests that cover almost half of all the plant species in the world, recalcitrant seed biology today is one of the most challenging areas of research.

Seeds immediately after collection contain a mixture of both viable and nonviable seeds and must, therefore, be separated prior to processing and storage. 'Incubated-dry-separate' method is a new technique by which viable and nonviable seeds can be separated in a column of water. This method is based on the principle that, in a mixture, following imbibition, the filled but nonviable seeds dry more rapidly than the filled viable seeds. Drying results in a large differential in seed moisture content or specific gravity and this makes the drier, nonviable seeds to float so that they can be easily separated from the wetter, viable seeds which sink to the bottom. However, even more attractive but non-destructive techniques are the 'Computerized Axial Tomography' (CT) and the 'Magnetic Resonance Imaging' (MRI) which were elucidated by Jack A. Vozzo from USDA Forest Service, USA. In CT, single plane images of the entire seed are stored in computer programs and all consecutive planes are reconstructed into a 3-D model of the seed showing its internal organization. MRI, however, images the mobile proton distribution which in turn represents the amount and distribution of the hydrogen ions of bulk water and fatty acids. By this method, metabolic paths can be followed from point to point inside the seed and the physiology and morphology of the seeds can be clearly understood using different false colours. These methods help in distinguishing the live full seeds from the dead full seeds and the empty seeds.

Drying of seeds up to their level of critical moisture content and the actual process of drying are also important. While drying of 'orthodox' seeds without affecting viability is not problematic, that of 'recalcitrant' seeds may lead to severe oxidative damages. Unlike the orthodox seeds, the recalcitrant seeds require a small amount of 'matrix bound' water for their viability. When this water is lost due to drying, the integrity of membrane is irrevocably damaged and seed viability is rapidly lost. However, according to Patricia Berjak from the 'Plant Cell Biology Unit', University of Durban, South Africa, the time taken for water to be lost is of critical significance to the degree of dehydration that a recalcitrant seed will tolerate. She found that the oxidative damage due to the free radicals generated during drying could be prevented in species like *Ekbergia* by rapid drying.

The second important component of conservation research is the development of scientific and proper nursery techniques for the planting of quality seeds as without it, even heavy investments in the collection, processing and storage of seeds may go waste. Therefore, an understanding of the requirements for seed germination, sapling growth and soil science of the plantation site is essential for the establishment of quality saplings. Today, the use of mycorrhiza in this area is fast becoming a novel approach as was indicated by B. N. Johri, Forest Research Institute, Dehradun.

Biotechnological approaches can contribute greatly to afforestation programmes as superior and elite plants can be mass-multiplied through micropropagation. Moreover, efficient conservation of threatened germplasm through artificial seed production and cryo-preservation is an important technique. However, M. R. Ahuja, Institute of Forest Genetics,

Federal Republic of Germany maintained that a number of parameters should be accurately determined prior to cryo-preservation, viz. (i) cryo-preservation potential of each recalcitrant species, (ii) assessment of the amount and effect of damage due to cryo-injury of both the cotyledon and embryonic axes separately, and (iii) the differentiation capacity of the explants after cryo-storage. The cryo-preservation technique can, therefore, be of any use only when these parameters are optimized.

Lastly, identification of certain marker molecules and their biochemical paths which act as modulators of the response to stress may probably pave the way to transgenic recalcitrant seeds tolerant to desiccation stress.

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Participatory approach in biodiversity conservation: A case in the Himalaya

The core group Conservation of Biological Diversity at G.B. Pant Institute of Himalayan Environment and Development, Kosi-Almora initiated a programme 'Peoples' participation in Himalayan biodiversity conservation' in March 1995. The programme envisages to (i) impart education in biodiversity, (ii) generate public opinion, and (iii) motivate youngsters to conserve and utilize local biodiversity. The programme focused on the linkages between biodiversity elements and needs of local people. The first phase of the programme included training workshops/discussion meetings and follow up action. The following target groups were recognized: (i) Resource group: rural inhabitants, peoples' representative, NGOs and local officials, (ii) Management group: teachers, academics, and scientists, (iii) Work force group: students. Over 400 participants representing these target groups have been given training in four training workshops organized in different remote localities of District Pithoragarh in Kumaun Himalaya. While analysing the responses of participants in first three workshops, it was realized that attention should be focused on students and teachers.

The IV Training Workshop, with desired re-orientation of programme features, was organized at LWS Girls Inter College Bhatkot, Pithoragarh on 24–25 October 1997. Fifty-seven participants (students/teachers) representing 23 educational Institutions attended the workshop.

The most important component of the workshop was on-site training, featuring six capsules on biodiversity (1) Status, (2) Assessment, (3) Valuation, (4) Conservation, (5) Soil, water and biodiversity interdependence, (6) Participation and role of target groups. Participants were introduced about biodiversity in general, its components and levels. Practically feasible techniques for assessing local biodiversity and its values were demonstrated under first three capsules. The last three primarily dealt with conservation. *In situ* and *ex situ* conservation techniques were explained. Under *ex situ* technique, participants were exposed to fundamentals and importance of tissue culture techniques. Relationships and interdependence of soil, water and biodiversity were described and demonstrated through posters. Finally, under participation capsule, besides explaining and providing the formats for collecting information on local biodiversity, possibility of developing preservation models in school/college campuses was discussed. Importance of such models in ensuring maintenance of indigenous components of biodiversity was explained by furnishing examples of the successes of the earlier efforts in this direction. Revegetating degraded lands, development of nurseries and propagation packages of important species were also focused. Training on value addition as a practical option to augment their economy through effective utilization of bio-resources developed special interest among participants.

A special feature of the workshop was a lecture delivered by V. K. Gaur of Indian Institute of Astrophysics, Bangalore, on evolution of earth and its living organisms. The exposition of the theme was received by the participants with great interest. The follow-up action under this programme is being given utmost importance. All the participating institutions are expected to initiate biodiversity-related activities through an identified team under the leadership of trained teachers and students. This is being implemented through the involvement of district authorities of the Department of Education. The area-specific feedback from the participants will be analysed and documented by the Institute. This will also be complemented with scientific inputs generated by the Institute and other collaborating institutions. The programme activities are proposed to be extended to other parts of the Indian Himalaya through the units of this Institute.

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