NBRI transfers Plant Growth Promoting Bacillus-based Technology to Biotech International Ltd, New Delhi

In this Issue

The Green Revolution of the 1970s had brought for India security on food front, but at the cost of agricultural ecosystem. There has been qualitative and quantitative degradation of land, water and bioresources. The fertile land has become uncultivable due to water logging and salinization. Environmental security is, therefore, no longer peripheral to the issue of food and nutritional security. Environmental access to food can be best realized by resorting to organic farming, the principal components of which should be integrated. The work being persued at the National Botanical Research Institute (NBRI), Lucknow, on biofertilizer and biopesticide development is an important step in this direction.

Dr R.A. Mashelkar, Director General, CSIR (extreme right) handing over the agreement documents for plant growth promoting Bacillus-based technology developed by NBRI, to representative of Biotech International Ltd, New Delhi. Dr P. Pushpangadan, Director, NBRI, is also seen (extreme left)
Inoculation of seeds or soil with beneficial microorganisms for crop improvement has been practised for decades. However, a major factor coming in the way of the successful commercialization of bioinoculants was inconsistency of field test results and quality of product(s) after commercialization. The establishment and performance of these are severely affected by environmental factors, especially under stress conditions encountered in soil, e.g., salt, pH, and temperature. Therefore, it is desirable to provide stress tolerant bacteria as inoculants. At NBRI, Dr Shekhar Nauniyal’s group has tried to overcome these challenges using a focused approach to ensure that technology developed for the purpose is scientifically sound, easy to use, and proven to deliver consistent and valuable product. Work on the development of the technologies was initiated at NBRI when the Director General-CSIR’s Special grant was sanctioned to Dr Nauniyal in 1995. Since then NBRI has obtained and filed several patents for the technology developed using novel plant growth promoting bacteria namely Pseudomonas, Bacillus and Rhizobium. The products thus developed have the potential to control phytopathogenic fungi; promote plant growth; improve tolerance for abiotic stresses; and solubilize phosphate even under abiotic stress conditions. The products are useful as plant growth enhancers and biopesticides for seed, soil and foliar applications.

The Pseudomonas based technology was successfully transferred to a leading biotechnology company MBI International, USA in 2000. On 30 August 2004 NBRI’s Microbial Inoculant Technology consisting of Bacillus has been transferred to Biotech International Ltd. (BIL), New Delhi, in the presence of Dr R. A. Mashelkar, DG-CSIR, for commercial exploitation. BIL is the largest Indian biotechnology company in private sector, manufacturing biofertilisers and biopesticides with global marketing capabilities. The technology has been developed by Dr Nauniyal in collaboration with Dr H. B. Singh, Head, Plant Pathology Group. The niche microbes involved have been isolated, identified and characterized under quality-controlled conditions. A process has been developed for commercial manufacture of these products keeping in view local needs and national/international market potential. Powerful blend of novel microbes (Pseudomonas, Bacillus, Rhizobium and Trichoderma) constitute a synergistic and stable blend of inoculants that may be applied to agronomic crops, flowers, and vegetables, and to digest organic wastes such as press-mud, farm manure and vermicompost, etc., and to recover degraded ecosystems.

NBRI’s networking with ‘BIL’ through technology transfer will ensure niche benefits for farmers. In terms of environmental benefits the impact will be innumerable, as it will lead to reduced dependence on chemical fertilizers for agricultural growth. The deterioriation in soil and water quality will be checked if the use of the new technologies and its products move on the anticipated path.
Nanoparticles from Cationic Copolymer and DNA that are soluble and stable in common organic solvents

SOUVIK Maiti and Munia Ganguli of the Institute of Genomics and Integrative Biology (IGIB), Delhi and Kizhakkedathu N. Jayachandran of University of British Columbia, Vancouver, Canada in their paper published in the Journal of American Chemical Society (Vol. 126 (1), 2004) have reported for the first time an easy method for making DNA soluble in different organic solvents. The importance of this lies in its potential for designing new materials based on DNA.

The unique double helical structure of DNA along with its reversible recognition properties, ability to completely control the length and content of oligonucleotides and the wealth of enzymes available for its modification have made DNA extremely suitable for several novel applications, some of which are even non-biological in nature. Miniaturization of biosensors and biochips into the nanometer scale regime, fabrication of nanometric objects using DNA as a template, and replacement of silicon devices with single DNA molecule-based computational systems are just a few of the emerging and fascinating applications of DNA.

Although DNA is amenable for tailor-made applications, it also has a major limitation due to its insolubility or only partial solubility in any common organic solvent because it loses its base pairing recognition properties. Making DNA soluble in organic solvents such that it retains its biologically important properties is thus a challenge.

Cationic amphiphiles such as surfactants and lipid molecules have been used in the past to make DNA soluble in organic solvents. However, these amphiphile-mediated DNA complexes are not soluble either in water or in other common organic solvents. In recent years, it has been demonstrated that polycation grafts with water-soluble polymers form nanoparticles that are stable in water when they interact with DNA molecules. The DNA present in these nanoparticles is inaccessible to the action of the enzyme Dnase I and can be transfected into the cell. The polymer-based nanoparticles are potential candidates for a wide multitude of applications.

In this paper, the authors have shown that random cationic copolymers from methoxy poly (ethylene glycol) monomethacrylate (MePEGMA) (3-methacryloyloxypropyl)trimethylammonium chloride (MAP-TAC) are also able to form stable water-soluble nanoparticles when they interact with DNA. The researchers reported that these nanoparticles from DNA and cationic random copolymer (RCP) with 94 mol % PEG content are not only stable in water but also in different organic solvents such as acetonitrile, benzene, dimethyl sulfoxide and tetrahydrofuran.

To study the solubility behaviour of the DNA-containing nanoparticles in different organic solvents, the researchers lyophilised the particles and re-dissolved them in different organic solvents. It was found that the nanoparticles did not break down in the solvents nor did they aggregate to form bigger particles. These retained their original size and shape as is observed in aqueous medium. As PEG is soluble in all the solvents tested, the solvophilic effect arising from PEG segments of the nanoparticles not only makes them soluble but also prevents aggregation due to steric repulsion and reduces nonspecific interactions among the particles themselves or with surroundings, thereby making them stable too.

It was confirmed that the DNA in nanoparticles is the double-stranded helical form. All of the solutions containing nanoparticles were practically transparent, and no aggregation was observed over a course of several weeks. Atomic Force Microscopy revealed the spherical nature of the nanoparticles in organic solvents. Other observations also revealed that the systems are stable and remained soluble over a period of time.

Thus it is clear that DNA can be made soluble in different organic solvents with the help of PEG based random cationic copolymer and that its helix conformation can also be preserved.

The methodology used in this study in making DNA soluble in organic solvents would definitely be of relevance in designing DNA-based advanced materials and in making DNA more compatible with organic building blocks and for creating materials for applications such as reaction catalysis. Another possible application is the long-term stability of the particles in a Dnase I-free environment, which is important for gene delivery. It also allows the use of traditional physicochemical methods to study the molecular characteristics of such DNA-based complexes in organic solvents.

The paper presents, what is probably the first report ever, describing the process of making DNA soluble in a variety of non-biological solvents using cationic polymer.

15 DECEMBER 2004
THE R&D programmes at the Centre for Cellular & Molecular Biology (CCMB), Hyderabad, pertain to Biotechnology and Biomedicine - Tumour Biology, Cataract and other eye diseases, DNA Fingerprinting and conservation of endangered species, Transgenics and aquaculture, Infectious diseases, and Applied processes and products; Genetics and Evolution - Molecular basis of sex determination and evolution of sex chromosomes, Microbial/fungal genetics, and Extremophiles; Cell Biology and Development - Molecular basis of capacitation of spermatozoa, sperm associated proteins and fertility potential of spermatozoa, Receptor Biology, Molecular basis of development, Hormone regulation, and Chromatin structure and function; Molecular Biology - Signal transduction, Eukaryotic transcription mechanisms, Nuclear pores and lamins, Host-guest interactions in plants, Enzyme structure, function and regulation, and Gene silencing; Biochemistry and Biophysics - Intracellular transport of proteins, Membrane active molecules and membrane organization, Protein structure and conformation, Mathematical modelling of biological processes, and Structural Biology; Genomics - Molecular analysis of human genetic disorders, Repromics and chromosome biology, Genome analysis, and Functional genomics using transgenic and gene knockout mice. During the year 2002-2003 the centre published 94 research papers in peer-reviewed international journals, 26 research papers were in press, four patents were granted, nine were filed and two US patents were processed.

A brief account of the accomplishments in basic research is presented here. The accomplishments in the domain of applied research and those intended to meet the societal needs will be covered in one of the forthcoming issues of this newsletter.

**BASIC RESEARCH**

**Genetic causes of male infertility**

Y Chromosome deletions in azoospermic men in India - Genetic factors cause about 10% of male infertility. Azoospermia factors (AZFa, AZFb, AZFc) are considered to be the most important for spermatogenesis. Scientists at CCMB have made an attempt to evaluate the genetic cause of azoospermia, Y chromosome deletion in particular, in Indian men. A total of 570 men, including 340 azoospermic men and 230 normal control subjects were analyzed. The DNA samples were initially screened with 30 sequence-tagged site (STS) markers representing AZF regions (AZFa, AZFb, AZFc). Of the azoospermic men analyzed, 29 (8.5%) showed Y chromosome deletion, of which deletion in AZFc region was the most common (82.8%), followed by AZFb (55.2%) and AZFa (24.1%). Microdeletions were observed in AZFa, whereas macrodeletions were observed in AZFb and AZFc regions. Deletion of heterochromatic and azoospermic regions was detected in 20.7% of the azoospermic men. In seven azoospermic men, deletion was found in more than 8.0 Mb, spanning AZFb and AZFc regions. Sequence analysis at the break points on the Y chromosome revealed the presence of L1, ERV, and other retroviral repeat elements. They also identified a 240-kb region consisting of 125 bp tandem repeats, predominantly comprised of ERV elements in the AZFb region. Histological study of the testicular tissue of the azoospermic men, who showed Y chromosome deletion, revealed complete absence of germ cells and presence of only Sertoli cells.

A highly conserved human gene encoding a novel member (WDR13) of WD-repeat family of proteins - CCMB scientists have identified and characterized a human gene designated as WDR13 (nomenclature approved by Human Gene Nomenclature Committee), which encodes a novel member of ED-repeat family of proteins. The gene has been completely sequenced, its structural organization unveiled, chromosomal location determined and promoter region identified in the 5′ UTR, which interestingly showed a testis-specific activity in the transgenic animals studied. High levels of sequence similarities across the species testify evolutionary functional significance of this gene.

**Genome-wide analysis of Bkm sequences (GATA repeats)** - Bkm (Banded krait minor) satellite DNA sequences (GATA repeats) have been shown to be associated with the sex determining chromosomes of various eukaryotes and have been implicated in the evolution and differentiation of sex chro-
mosomes in snakes. CCMB scientists have analyzed the GATA repeats of human genome, specifically the Y-chromosome, and other model organisms to understand the possible functional and potential role in higher order chromatin organization.

Extensive analysis of GATA repeats in the prokaryotic and eukaryotic genomes, which have been completely sequenced so far, has revealed that GATA repeats are absent in prokaryotes and have been accumulated in higher organisms during the course of evolution. In human, the Y-chromosome has the highest GATA repeat density, which predominantly exists in the Yq centromeric region. Generally, occurrence of repeats in the genomes decreases steadily as the length of the repeat increases. In contrast, CCMB scientists found that the occurrence of GATA repeats increases as the length of the repeat increases from six tandem repeats onwards and peaks at (GATA)_{10-12}. This has not been observed with any other simple repeat. Distribution of (GATA)_{10-12} along the chromosome with their close proximity to Matrix Associated Regions (GATA-MAR) suggests that it may be demarking chromatin domains for a coordinated expression of genes residing in these domains. Supplementary data is available at http://www.ccmb.res.in/bkm/gata.htm.

Triplet repeats in human genome: distribution and their association with genes — A study was undertaken on simple sequence repeats (SSRs) or microsatellite repeats which are found abundantly in many prokaryotic and eukaryotic genomes. Among SSRs, triplet repeats are of special significance because some of them have been linked to various genetic disorders. The analysis of triplet repeats in the complete human genome from the publicly available sequences revealed that AGC and CCG repeats were predominantly present in the coding regions of the genome while UTRs and the upstream sequences contained CCG repeats in relative abundance. Analysis of density of triplet repeats (bp. Mb) revealed that AAT and AAC were the rare repeats found in human genome. They could identify about 2135 known or predicted genes that were associated with at least one of the triplet repeat types. A large proportion of putative transcripts that were identified by gene finding programs were found to be associated with triplet repeats. These transcripts will be the candidate genes for analysis of triplet repeat expansion and their possible association with disease phenotypes. Identification of 171 genes which contain a minimum of ten repeat units will be of particular interest in future in correlating their association with any disease phenotype due to the expansion potential of repeats present in them. The list of genes and other details of analysis are given in the online supplementary data (http://www.ingenovis.com/tripletrepeats).

Analysis of DAZ gene family in infertile men in India — DAZ gene, which is present in AZFc region, is important for spermatogenesis. The size of the DAZ gene cluster is about 380 kb, which consists of seven copies of DAZ; of these four copies are located relatively close together in deletion interval 6 on the Y chromosome (Yq11). These four copies of DAZ genes exist in two clusters, each comprising of an inverted pair of DAZ genes (3′→f5′:: 5′→3′). Cluster 1 includes DAZ1 and DAZ2, and cluster 2 includes DAZ3 and DAZ4.

Scientists at CCMB have analyzed DAZ gene clusters in 539 males, which includes 367 men with azoospermia, 72 men with oligozoospermia and 100 fertile men in order to find out the role of DAZ in infertility. Of the 4 DAZ copies, deletion of DAZ3 and DAZ4 was found to be significantly associated with male infertility.

Mutation analysis of autosomal DAZ (DAZL) in infertile men — DAZ gene is present on the Y chromosome of humans, great apes and old world monkeys; but in other mammals it is present on autosomes. DAZL is an autosomal homologue of DAZ, located on the long arm of chromosome 3 (3q24). CCMB scientists analyzed a total of 367 azoospermic, 24 oligozoospermic and 100 control men, of which 4 azoospermic and one oligospermic individuals showed a single base insertion in DAZL. Two individuals showed insertion in exon 3, while the remaining three showed insertion in intron. In one individual an insertion of G was found at position 65 in exon 3, which converts Thr to His and introduces a stop codon. In another individual T to A transition at position 61 and an insertion at position 63 of exon 3, change the amino acids Ile to Asn and Thr to His and introduce a stop codon. Three individuals (A133, A347 and A364) showed C to T transition at nucleotide position 60 in exon 3, resulting in the change of Ile to Arg; but no insertion was found in control samples. In addition, we found one neutral SNP in this region; however, this SNP was already reported and has not been found to be associated with any disease.

Human Genome Diversity

Genetic affinities of the Andaman Islanders, a vanishing hu-
man population — The study of CCMB scientists on tribal populations of Andaman and Nicobar Islands has demonstrated that the Onge and the Jarawa represent a unique subtype of haplo group D not described so far in the world population. The presence of a hitherto unidentified sub-set of the mtDNA Asian haplogroup M, and the Asian-specific Y chromosome group D, testify that the Andamanese have closer affinities to Asian than to African populations and, therefore, are the descendants of early Paleolithic colonizers of South East Asia — the hunter gatherers and the first migrants who moved out of Africa about 60,000 - 100,000 years ago. The questions remain, how then these so called Andamanese reached Andaman? And are there any tribes in Indian mainland, which show resemblance with Andamanese and therefore, shed light on the root of migration? To answer these questions, they studied tribal population of Indian mainland. They observed YAP (Y-Alu Polymorphism) insertions in 27 individuals out of 47 samples in a tribe from Gujarat, West coast of India, as observed in their earlier studies in Onge and Jarawa tribes of Andaman and Nicobar Islands. SNP analysis of the above populations is in progress. In contrast to Andamanese, the Nicobarese have genetic affinities to groups widely distributed today throughout Asia, thus, the Nicobarese should presumably descend from Neolithic agriculturists. Further studies may throw light on the mystery of our own origins.

India: the cradle for a novel mitochondrial haplogroup R8 — The polymorphic 9bp motif (CCCCCTCTA) between cytochrome oxidase II (COII) and tRNA lysine genes (tRNA²lys) of mtDNA is present in two copies in the majority of people around the world. Our extensive analysis involving 3432 individuals belonging to different ethnic groups and geographical regions of India revealed both deletion and insertion. The 9bp deletion (1 copy) and insertion (3 copies) alleles were observed in 93 individuals. The deletion was observed in 76 (2.2%) individuals while the insertion allele occurred in 17 (0.5%). The maximum frequency of deletion was observed in the Nicobarese (45.8%) while the maximum insertion was observed in the Ao-Naga (7%). SNP analysis revealed at least four independent origins of the deletion and two independent origins of the insertion in the M haplogroup background. Nine additional origins of the deletion and two of the insertion were observed in N haplogroup lineages. Twenty-two Nicobarese and 2 Harijans of deleted samples classified to haplogroup B, whereas analyzed in the phylogenetic context of the total pool of Indian mtDNA sequences. Some of the samples with two copies of the 9bp motif also showed the same mutational pattern as the deleted samples. Regeneration and recombination are two different phylogenetic pathways that can explain this phenomenon according to the B5 pathway. Alternatively, CCMB scientists proposed a phylogenetic pathway, which invokes a novel phylogenetic clade R8 with a coalescent time of 31,130±5,300 years that relates subsets of Indian and Southeast Asian maternal lineages and infers an independent origin of the 9bp deletion in paraphyletic haplogroup B. In the light of present data, Eastern India seems to be a likely source for the spread of the carriers of haplogroup R8.

Repromics and chromosomal biology — CCMB has evolved an integrated approach that examines the defect globally at genomics and proteomics levels. In a study to understand the impact of ecogenetic polymorphisms on pregnancy loss, gerotyping of SNPs in CYP1A1, CYP2D6, NOS3, MTHFR, Prothrombin, Factor V Leiden and 6 SNPs in NAT2 gene (C481T, G590A, A803G, G857A, C282T and T341C) was carried out using a PCR-RFLP approach. Among the various polymorphisms studied, the frequencies of 2 SNPs in CYP1A1 namely the T6235C (p=0.023) and A4889G (p=0.29) were found to be significantly different between the women with miscarriages and control populations at 95% significance level indicating the importance of detoxification systems in influencing the success rate of pregnancy outcome.

Chromosomal and molecular genetic studies at CCMB have, for the first time, established that in a significant number of patients with varicocele, genetic defect in the form of either chromosomal abnormality or Y chromosome microdeletion is indeed responsible for impaired spermatogenesis. Among infertile men with varicocele, severe oligo-azoospermic and oligoasthenoterato-azoospermic men with varicocele have higher incidence of genetic defects than mild oligoazoospermic and azoospermic men.

Molecular analysis of human genetic disorders — CCMB scientists sequenced the coding regions of cationic trypsinogen gene (PRSS1) and trypsin inhibitor (SPINK) genes in 290 controls and 198 patients, of whom 120 were diagnosed as idiopathic (ICP), 41 as alcoholic (ACP) and 37 as hereditary pancreatitis (HP). No mutations in
PRSS1 gene were detected in any of the patients including hereditary pancreatitis, while N34S mutation was observed in SPINK1 gene of majority of HP patients (73%). Similarly, 26.8% of ACP (11 of 41) and 32.8% (39 of 120) of ICP patients also had SPINK1 mutations. N34S mutation was observed in both homozygous as well as heterozygous condition. In comparison, only 2.76% of control population had N34S/WT genotype (P<0.001). Irrespective of the etiology, mutations in PRSS1 gene were not found to be associated with chronic pancreatitis, including hereditary pancreatitis in India. On the contrary, N34S mutation in SPINK1 gene showed significant correlation in these patients.

Microbes from extreme environments and cold adaptation — A study of cold-loving organisms with respect to their diversity, distribution, seasonal variation and characterization led to the identification of a number of new species of bacteria viz., Sphingobacterium antarcticus, Arthrobacter flavus, Arthrobacter roseus, Kocuria polaris, Planococcus antarcticus, Planococcus psychrophilus, Halomonas glaci, Leifsonia rubra, Leifsonia aura and Sporosarcina momurdoensis. All these species were unique with respect to their ability to grow at low temperature and produced a number of enzymes of biotechnological potential. These enzymes were capable of catalyzing reactions at low temperatures. In addition, it was also observed that the ability of the organisms to adapt to low temperature depended on the upregulation of the desaturase genes (desA and desB), whereas desC, which existed as desC1 and desC2, was constitutively expressed.

The severe cold sensitive phenotype of P. Syringae when transformed with a plasmid that produces full-length RpoS (sigma subunit of RNA polymerase) is very significant from adaptation and evolutionary points of view.

The observations that the recD mutants of P. syringae produce a large amount of broken DNA resulting in an enhanced mutation frequency, indicates that the cold sensitive phenotype of recD mutant is perhaps caused by an inefficient DNA repair process in the bacterium at low temperature. In contrast, recD mutants of mesophilic bacteria such as E. coli are not defective for growth at low temperature. The study also establishes that the recD gene or RecD protein would be a good target for controlling low temperature adapted pathogenic and/or food-spoilage bacteria.

Genetic analysis of repeat-induced point mutation (RIP) — RIP is an unusual mutational process in the fungus Neurospora that causes duplicated DNA sequences to undergo multiple G:C to A:T mutations and methylation of cytosine residues. CCMB scientists had developed a convenient assay to score RIP by which they screened over 400 wild-isolated N. crassa strains for dominant suppression of RIP. One of the identified suppressor strains appeared to contain a chromosome segment duplication. Previously they had shown that the presence of a large duplication in a cross suppresses the occurrence of RIP in a smaller duplication, possibly by titration of the RIP machinery. In another suppressor strain, the suppressor mutation was mapped to linkage group 1 to the left of the mat locus. They also developed a strategy to isolate recessive RIP-defective mutations in the pseudohomothallic species N. tetrasperma, and also demonstrated that although RIP can spread from a duplication into the flanking single copy sequences, such spread is not efficient.

Functional role of lamin speckles — Towards studies on the regulation of the lamin A gene, the group identified two novel binding sites for transcription factors in an important regulatory region for the cell-type-specific transcription of A-type lamin isoforms. These factors belong to the winged helix family and the retinoic acid receptor family of transcription factors, which play essential roles in differentiation and development. Further, in studies on lamin organization, the group characterized a novel monoclonal antibody that recognizes detergent-susceptible lower order lamin structures in the form of small intranuclear foci, which are enhanced in the G1 phase of the cell cycle and are likely to be assembly intermediates.

Mechanism of induction of apoptosis by tumor suppressor p53 — The tumor suppressor protein p53 is activated in response to DNA damage or hyperproliferative signals resulting in cell cycle arrest or cell death by apoptosis. The apoptosis inducing property of p53 is very important for its tumor suppressor function. Previously, the group had shown that caspase-1 gene transcription is induced by p53 in response to activation by DNA damage. Blocking caspase-1 function either by a chemical inhibitor or mutant caspase-1, inhibits p53-dependent apoptosis. It was found that an activator of caspase-1, known as Ipaf (a structural homolog of Apaf-1), is induced transcriptionally by p53. Inhibition of Ipaf function by small inhibitory RNA results in reduced
apoptosis by p53. These results suggest that IpaF-Caspase-1 pathway may be an important mediator of p53-dependent apoptosis. This pathway may be acting independent of or parallel to the well-known Apaf-1-Caspase-9 pathway.

**Plant-pathogen interactions** — *Xanthomonas oryzae* pathovar oryzae (Xoo) causes bacterial leaf blight, a serious disease of rice. This group obtained the complete sequence of a novel 12 kb Xoo genomic locus that encodes six genes which are homologous to functions involved in lipopolysaccharide (LPS) biosynthesis and export. All six ORFs exhibited atypical G+C content and codon usage patterns that are characteristic of genomic islands which are acquired by horizontal gene transfer. The presence of this genomic island in Xoo strains that are distributed across a vast segment of the Asian continent, from India to Korea, suggests that it was introduced into the Xoo genome early in the evolution of this pathogen. Interestingly, this genomic island is absent in a variant Indian Xoo pathotype and a Xoo strain from Nepal. It appears that another horizontal gene transfer event had occurred in the progenitor of these two strains wherein the genomic island was replaced with an LPS gene cluster that is related to sequences in a xanthomonad that infects citrus plants. These data provide evidence, for the first time, of the substantial variation in LPS gene clusters within different strains of a plant pathogenic bacterium and indicate that these bacteria are under selection to undergo variation at this locus. The data are also indicative of the enormous range of genetic resources that plant pathogens can draw upon to counter adverse conditions that they might encounter under agricultural settings.

**Drosophila genetics** — In the fruitfly *Drosophila melanogaster*, wings and halteres are the dorsal appendages of the second and third thoracic segments, respectively. In the third thoracic segment of *Drosophila*, wing development is suppressed by the homeotic selector gene *Ultrabithorax* (*Ubx*) to mediate haltere development. CCMB scientists have observed that *Ubx* functions downstream to *Shaggy/GSK3β* to enhance the degradation of *Armadillo/β*-catenin, which causes downregulation of *Wingless* signaling in haltere discs. Furthermore, they have shown that enhanced degradation of *Armadillo/β*-catenin in haltere discs can be used as an assay system to identify additional positive and negative regulators of Wnt signaling. CCMB scientists examined the role of peripodial membrane in wing development. The peripodial membrane plays a significant role during the regional subdivision of the wing disc into presumptive wing, notum and hinge. The EGFR/Ras pathway mediates this function of the peripodial membrane. These results on signaling between squamous and columnar epithelia are particularly significant in the context of role of EGFR/Ras pathway in metastasis and tumor progression.

**Extreme conservation of non-coding DNA near the HoxD complex of vertebrates** — The group discovered an unprecedented conservation of non-coding DNA sequence adjacent to the *HoxD* complex, where stretches of hundreds of base pairs in a 7 kb region show 100% conservation from fish to human. Such a high degree of conservation, where no variation was allowed during -500 million years of evolution, suggests critical function for these sequences in the regulation of the *HoxD* complex. The group amplified and sequenced the corresponding regions from different species of mammals, birds, reptiles, amphibians and fishes. This has given vital clues about the evolution and conservation of sequences during diversification of vertebrate classes.

**Molecular biology of skeletal muscle growth and regeneration** — CCMB scientists have studied the role of adhesion-mediated signalling in modulating the uncoupling of arrest from tissue-specific gene expression. A new system for generating reversibly arrested myoblasts using pharmacological inhibitors of acto-myosin contractility has been established and extensively characterized using transfection of known signalling molecules. On continuing the analysis of suspension-arrested myoblasts, CCMB scientists found that the Rb family member p105 and the cyclin-dependent kinase inhibitor p27 were induced in G0, but not the CKI p21. Further, using microarray analysis, they identified and validated a number of genes that were induced in G0, but were rapidly suppressed upon cell cycle re-entry, making them candidates as regulators of the quiescent state. Using a retroviral gene trap approach, a gene was identified encoding the nuclear protein p8 that appeared to be involved in the regulation of G1, as RNAi mediated knockdown of its expression led to shortening of the G1 phase. Induction of the myogenic regulatory factor MyoD during the G0-G1 transition of synchronized myoblasts was analysed; and dissection of the signalling pathways that regulate MyoD expression was under progress. Altogether, the re-
results provide new information on regulation of the quiescent state and the integration of the cell cycle with tissue-specific gene expression.

Chaperone-like activity of a lens protein — Many small heat shock proteins including αA- and αB-Crystallins contain a well-conserved SRLFDQFFG sequence motif in N-terminal region. The constructs were made at CCMB deleting this sequence from αA and αB-crystallins, over-expressed, purified and these deletion mutant proteins studied which indicated that such deletion results in changes in oligomeric size and more interestingly increase chaperone-like activity.

The studies on in vivo functionality of α-crystallin indicated novel roles for α-crystallin. It was found that upon heat shock, all the α-crystallin translocates to nucleus and co-localizes with lamin A/C intra-nuclear network. Upon heat shock, lamin A/C network also undergoes structural reorganization indicating that α-crystallin has a major role to play in this reorganization. It was also shown that α-crystallin localizes with SC35, a splicing factor. Interestingly, α-crystallin does not translocate to nucleus of myotubes. This stage-specific requirement, co-localizing with SC35 indicated a possible role for α-crystallin in gene expression.

Peptide-membrane interactions — SNAP-23/25, members of a family of proteins essential for exocytosis, have a highly conserved central cysteine rich domain, which plays an important role in membrane targeting. More than one cysteine in this domain is modified by palmitic acid through a thioester linkage. In an effort to address the biological significance of acylation of this domain, the group generated synthetic peptides corresponding to the cysteine-rich region of SNAP-23 and covalently modified the cysteines with palmitic acid. The interaction of acylated and non-acylated peptides with lipid vesicles and natural membranes was investigated. The results indicated that palmitoylation was essential for membrane association. The palmitoylated peptides were able to fuse both model and natural membranes. The extent of fusion depended on the length of the peptides and the number and positions of covalently linked palmitic acids. Peptide-mediated fusion was suppressed by lysolipid and involved both outer and inner leaflets of the lipid bilayer, a characteristic of natural membrane fusion. The results suggested an important role for the cysteine-rich palmitoylated domain of SNAP-23 in promoting membrane fusion in cells.

Antimicrobial peptides — Generally antimicrobial peptides constitute an important part of innate immune system in organisms across the phylogenetic tree. However, the results of research at CCMB suggest that this may not be so at least in the skin secrections of the Indian toad Bufo melanostictus. Instead, indole alkaloids and butalinolides, which are also exogenous in origin, may function as antimicrobial agents in these toads.

Modelling spatiotemporal organization in biological systems — CCMB scientists studied the role of fluctuations in the dynamic behaviour of simple biochemical pathways having different types of feedback controls. The results showed that the same pathway, under some conditions can give rise to cellular dynamics that are exceedingly robust under noise, while in other parameter regimes it may lead to noise-sensitive behaviour. In ecology, the group studied model meta-populations of interacting host and parasite species to assess the role of external perturbation on their spatiotemporal dynamics. The results show that introduction of any heterogeneity, such as habitat loss or inhomogeneous distribution in demographic parameters, can lead to asynchrony in spatiotemporal dynamics in the host-parasite metapopulations. It is known that synchronization of dynamics across space increases the risk of population extinction in large spatial scale. Thus, heterogeneity can help increase species persistence.

Calcium binding is a widespread feature of the beta gamma-crystallin superfamily — It has been shown at CCMB thatAbsent in Melanoma-1-g1(AIM1-g1) binds the calcium-mimic dye Stains-all, the calcium probe terbium and 45Ca. AIM1-g1 binds calcium (Kp30 μM) with a comparatively higher affinity than bovine lens gamma-crystallin (90 μM). The AIM1-g1 domain is as stable as domains of beta gamma-crystallins betaB2- or gamma-crystallins). Despite the sequence variation, AIM1-g1 folds like a beta gamma domain, binds calcium and undergoes dimerization. Based on the results, it is suggested that calcium binding is a widespread feature of the superfamily.

Understanding the structural basis of function — The thermostability of a Bacillus subtilis lipase has been enhanced nearly 300-fold through directed evolution approaches. In order to understand the structural basis for the enhanced thermostability, crystals of a thermostable triple and double mutants were obtained. High resolution X-ray data from an in-house system were collected and the structures solved using the molecular replacement method. The analysis, currently in progress, is expected to provide valuable insights into the structural basis for thermostability and clues for further improvement of the thermostability using rational design.
NAL celebrates Foundation Day

The National Aerospace Laboratories (NAL), Bangalore, established on 1 June 1959, is now 45 years old. This year's Foundation Day celebrated recently was particularly special coming as it did just three days after the successful Saras inaugural flight.

Dr B. R. Pai, Director, NAL, began his welcome address by paying a tribute to NAL's first Director, Dr P. Nlakantan, and marvelling at his vision of planning a 4ft trisonic wind tunnel as early as in 1960 when there wasn't even a whiff of any major national aerospace programme. Dr Pai also greeted his predecessor, Dr T. S. Pradh - NAL's fifth Director — and Prof U. R. Rao who graced the gathering.

This year's Foundation Day lecture, the 18th of the series, was delivered by Dr G. Madhavan Nair, Chairman (ISRO).

Dr Nair’s lecture on Future Space Transportation Systems was truly a remarkable narrative. What one found especially pleasing was how ISRO has its roadmap so wonderfully lined up even up to the year 2025. The lecture itself covered wide ground: ISRO’s 39+4 missions, applications (broadcasting, meteorology, communication, developmental), evolution of ISRO’s launch vehicles, today's concerns (expensive and infrequent launches, no abort capability, no or minimal reusability, non-standard payload interfaces) and tomorrow's challenges (reusable launch vehicles).

Informative observations included facts such as: ISRO's first satellite has one transponder onboard, today's satellites offer 36 transponders; the resolution of satellite pictures has improved from 1 km to 1m; 85% of TV channels covered by INSAT systems etc.

Dr K Yegna Narayan delivered the NAL Technology Lecture, which was the seventh in this series. Dr Narayan spoke engagingly and compellingly on Saras: from an idea to first flight. The narrative talked of the highs and the lows and the agony and the ecstasy, of leading a Saras-like programme. By dividing the Saras programme into the early years (1990-94), the middle — and frustrating — years (1995-99) and the years of success and achievement (1999-2004), Dr Narayan forcefully brought home the point that Saras was effectively a five-year programme ("it bothers me when the media uses expressions like 'long delayed' or 'finally' with reference to Saras— the truth is that we flew the plane in just five years after the money came in!").

The NAL Annual Report was released on the occasion. NAL Outstanding Performance Awards were distributed and prizes were distributed to children of NAL employees excelling in academics or sports.

Shri M. R. Nayak, Head, TS proposed a vote of thanks.
THE First seminar under the recently formed Tea Improvement Consortium (TIC) of Assam with the Regional Research Laboratory (RRL), Jorhat, as its member, was recently held at RRL-Jorhat to deliberate on the present status of tea and futuristic approaches for tea improvement. More than 30 scientists from Tea Research Association (TRA), Tocklai, Jorhat, Assam Agricultural University (AAU), Jorhat, Tezpur Central University, Tezpur and the host institute attended the seminar. Prof. P. C. Deka, Vice Chancellor of Tezpur Central University and Dr M. Hazarika, Director, Tea Research Association were the Guests of Honour.

Dr P. G. Rao, Director, RRL-Jorhat, extended a warm welcome to the participants and said that the tea industry is fortunate to have the support of scientists. He opined that the scientists should think of likely problems on tea and tea-related issues and work together to give ready solution to the industry. He suggested that there is a need for collaboration of researchers from different institutions.

Prof. P. C. Deka informed that a brain storming session had been held at TRA and it was there that the decision was taken to form TIC. After a month, TIC was initiated and a second group was formed to prepare the guidelines of TIC after thorough study of the by-laws of other associations. The idea was to bring closer interactions among scientists with different expertises and to scale up the products in the laboratory to industry level. He said that the expertise lies in different fields and sharing of knowledge is essential for funding agencies to come forward for sponsoring the joint projects. Commenting that this was just the beginning, Dr M. Hazarika said that the ITC was making good progress and emphasized that steps should be taken together to lead to logical end. Talking of tea as a commodity, he said it has to be improved in quality and quantity for the consumers. Today the priority has changed as tea is in surplus production and the aim should be higher quality and higher productivity. Compared to the world scenario, the Indian tea market does display a bright future. Unless the tea industry receives help, all exercise would be futile, he opined. Conservation is one of the problems, he said. He also identified some projects that could be initiated for funding by the Department of Science & Technology (DST), Government of India.

As part of the Inaugural Programme of the TIC, four lectures were delivered by scientists from TRA, RRL, AAU and Tezpur University. Dr Sudipto Das, TRA spoke on ‘Futuristic strategies for improvement of tea’, Dr B. S. Dileep Kumar, RRL-Jorhat spoke on ‘Plant growth promoting Rhizobacteria: a biotechnological tool for crop management in tea plantations’ and Dr D. Konwar, Tezpur University spoke on ‘Biotechnology in tea improvement’ which was followed by panel discussion amongst the members. Through the panel discussion, the house identified a few projects on tea improvement and took the unanimous decision to formulate six joint research projects in the area, which would have active collaboration with TRA, RRL, AAU and Tezpur University.

The bye-law of TIC was adopted at the meeting and it was decided that the scientists and institutions/industry working on tea should be invited to join TIC as individual or institutional members. The next meeting of the TIC was proposed to be held at AAU, Jorhat.
RRL-Jorhat hosts Interactive Meet on Food-based Industries in NER

The Regional Research Laboratory (RRL), Jorhat, hosted in the recent past an Interactive Meet on Development of Food-based Industries in the North East Region (NER). RRL-Jorhat in collaboration with the Central Food Technological Research Institute (CFTRI), Mysore, jointly interacted with key persons capable of making an endeavour for the development of food-based industries in the region and evolving an action plan towards achieving this goal. The meet was a preliminary interaction for exploring the scope for furtherance of the objective and ensuring closer ties.

Welcoming the participants/delegates Dr P. G. Rao, Director, RRL-Jorhat briefly explained the purpose behind the meet. He said that recently he had been to various areas of the NER in connection with the CSIR Diamond Jubilee exhibitions. During these exhibitions he met a large number of people who expressed their willingness to go in for setting up of food-based industries in the region. He said that he also noticed that most of these places have potential for the establishment of food processing industries. Dr Rao said that CFTRI and RRL-Jorhat could together play a major role in terms of providing technological and other S&T inputs for such ventures. What is required is sufficient political will and policy decisions on the part of the government and appropriate entrepreneurship of the people, he remarked.

Dr V. Prakash, Director, CFTRI, made a presentation about CFTRI and spoke on the role of CSIR in establishment of the Food Processing Industry with focus on CFTRI. Mentioning the agenda for a food processing industry in NER as most appropriate he touched upon the finer points about the game plan, i.e., how to go about it, the limitations and problems as well as the prospects. He also elaborated on the technologies available at CFTRI for food based-industries. He mentioned that the entrepreneurship in the region is very powerful, which needs to be capitalised in terms of market, to work for prevention of food losses over the years, to utilize by-products raw material for value addition like Mango seed, Spice oil, enriched oleo-derivatives technology and natural food colour technologies. He spoke on Patent syndrome — patents not for money but for protections, and on food safety level. He suggested that an incubation centre could be established at RRL with the available facilities to train the trainers who in turn would take up the training programmes for the entrepreneurs. He spoke on Societal Missions such as Nutrition Mission for the country and said that the approach should not be individualistic; rather it should be a Team India approach involving the government, entrepreneurs, financial institutions and research organisations. He suggested that quality should be the only benchmarking of the work.

During interactions subjects such as setting up of Pineapple and its by-products processing, turmeric, vanilla, ginger oil processing, coconut and coconut water processing, cardamom extraction, milk-products, passion fruit and its seeds processing, bio-packaging industry, etc., were discussed. Finally, it was decided to identify and concentrate on a few specific subjects and then to select fifty efficient people for a short-term training course to be conducted at the Intense Training Centre at RRL. Some four or five trained people would be ultimately selected to be sent to CFTRI for further training on a specific product. It was also felt that financials must come forward and the government should play a handholding role. It was also felt that the entrepreneurs must keep up interacting even after installation of the unit for technology upgradation.

Nineteen experts in the field, policy makers, concerned Government Departments, marketing and industrial development managers and interested individuals attended the Meet.

Owing to the availability of rich natural resources in food-based materials in the region with a strong world-class technological support and research base in the country as well as in the region, it urgently requires an action plan to be developed and encourage small/medium scale industries based on these resources. According to the Shukla Commission Report (March, 1997) both agriculture and forestry is the bedrock on which the Northeast region has to be built up. The economy of the NE region is primarily agrarian, but it is deficient in its food supply, importing grain, oilseeds, sugar, meat, fish and eggs apart from other civil supplies from distant parts of the country. The import bill of the region is in the range of Rs 2500 crore per annum. But region’s economy can generate a surplus. Effort will be on to ensure that it is enabled to reach its true farm potential within a decade. Each of the NE states has vast possibilities for growing a range of
fruit and vegetables, tuber crops, tapioca and spices. Mizoram, for example, is well placed to produce passion fruit. There is a tremendous scope for enhanced productivity of citrus, pineapple, banana and other varieties through tissue culture and development of breeder seed farm. Vegetables and crops like banana can be replaced by more productive and disease free annuals. The hills can exploit niche markets and provide off season fruit and vegetables to the plains. Crops like ginger, turmeric, coffee, cashew, large cardamom, pepper, arecanut, jackfruit, lemon grass, citronella and a host of very valuable herbs and medicinal plants, orchids and a whole range of season flowers can be developed. The region is the largest producer of tea in the country with Assam as the leading tea producer producing 50% of the country’s total tea production followed by Tripura which is the fifth largest tea producer in the country. Arunachal Pradesh produces tea which closely resembles the world famous Darjeeling tea of West Bengal. The lone tea unit of Arunachal has been running profitably for quite some years and this potential could be tapped. Sikkim produces 80% of India’s large cardamom which enjoys high value export market in the Middle East. Nagaland has immense potential for horticulture due to the varying soil and agro-climatic conditions. With proper planning and investment, the cultivated area under horticultural crops and production can easily be quadrupled. Likewise food products sector account for bulk of the industrial production in Assam and Nagaland. In Nagaland, food and food products account for 11% of the total output of the state. As per records available, the North East and Sikkim received financial assistance to the tune of Rs 13.566 million for its various projects from the Department of Food Processing during 2000-2001. The thrust areas in the agro-processing sector as identified by the North-Eastern Development Finance Corporation (NEDFi) are canned or bottled products, packaged products, frozen products, dehydrated products, oleoresins, meat, milk, poultry, cereal based products, edible oil, fodder, jute and mesta, essential oils and fragrances and plantation crops like tea, jute, rubber and coffee.

Workshop on Advanced Materials for Environmental Applications

THE National Environmental Engineering Research Institute (NEERI), Nagpur, and the National Institute for Material Science (NIMS), Tsukuba, Japan, jointly organized a one-day workshop on “Advanced Materials for Environmental Applications” at NIMS, Tsukuba, Japan, in the recent past. This workshop was organized under the research collaboration between NEERI and NIMS in the field of ‘Development of Advanced Materials for Environmental Applications’.

Development of advanced materials is one of the most important objectives towards resolving environmental problems as well as to achieve sustainable development. The ongoing R&D in materials science all over the world therefore, focuses on innovative approaches to develop various materials for their possible applications in fairly complex environmental problems. This not only involves scientific capabilities in material design and synthesis, but also equal importance is being given to understand the exact requirements and practical conditions of material applications. Remarkable progress has been made in the last decade towards the development of advanced materials through various innovative approaches, including synthesis and functionality, accompanied by structure elucidation/documentation and more recently molecular modeling aided interpretation/prediction of structure property relationship for a variety of materials. Such studies are bound to add significantly to the existing knowledge of molecular design of tailor-made materials for specific applications including environmental applications. In order to address these emerging areas the first two NEERI-NIMS workshops were organized during 7-8 January 2003 and 20-21 January 2004 at NEERI. These workshops stressed on the importance of understanding the recent advances in materials synthesis and characterization, and the applications of materials for environmental pollution control. These workshops offered an opportunity for direct interactions not only between NEERI and NIMS scientists but also to scientists from other Indian R&D institutes.

The third workshop was organized at NIMS, Japan, so that various groups/centers of NIMS could also participate in the workshop, apart from Japanese industry and academia. The presentations on recent advances in theoretical design, synthesis, and characterization of...
Various materials were made. The different materials discussed included, metals, metal oxides, mixed oxides, zeolites, mesoporous materials, perovskites, silicon oxides, clays etc for a wide range of environmental applications. Some papers on new materials such as surface modified molecular sieves, substituted and un-substituted perovskite materials, visible-light-active TiO$_2$ photocatalysts, ZnO$_2$ based semiconductors/photocatalysts, their detailed synthesis and various possible applications were discussed. These materials were projected for their potential environmental applications in the areas of indoor air quality, diesel exhaust emission control, hydrogen storage and supply, catalytic methane combustion, water splitting, artificial photosynthesis, water and waste-water treatment etc. The presentation from industry emphasized their efforts towards control of environmental pollution through process modifications and more judicious use of resources. The various participating institutes in the third NEERI-NIMS workshop were Tokyo University of Science, Tokyo; Asahi Glass company, Japan; Fujitsu Laboratory, Japan; Hokkaido University, Japan, apart from NEERI, Nagpur and different Laboratories/Groups of NIMS, Japan.

The following lectures were delivered during the 3rd NEERI-NIMS workshop: ‘Recent Research of Environmental Materials in AML/NIMS’ by Dr H. Haneda, Director, ECG/AML/NIMS; ‘Materials in Environmental Protection — NEERI’s Approach’ and ‘Fuel Cells: Challenges and Opportunities for India’ by Dr S. Devotta, Director, NEERI; ‘Present Status of Lead-Free Piezoelectric Ceramics’ by Prof. T. Takanaka and Dr H. Nagata, Tokyo University of Science; ‘Advanced Materials for Air Pollution Control’ by Dr Nitin K. Labhsetwar, Scientist, NEERI; ‘Environmental Purification Materials in Ecomaterials Center/NIMS’ by Dr H. Yamada, Dr Y. Watanabe, Dr K. Tamura, Director; ‘Use of Spray Pulsed Injection Reactor for Hydrogen Production by Reforming of Iso-octane and Enhancement by Non-thermal Plasma’ by Shri R. Biniwale, Scientist, NEERI/Hokkaido Univ.; ‘Environmental R&D in Fujitsu Laboratory’ by Mr M. Kawarada, Deputy Director, Fujitsu Laboratory; ‘Visible-Light-Active TiO$_2$-Based Photocatalysts and their Potential Application in Air Purification’ by Dr Di Li, ECG/AML/NIMS; and ‘Charge Separation at Single-Crystalline Rutile/Anatase Interface Enhancement of Photocatalytic Activity’ by Dr T. Mitsuhashi*, Dr T. Miyagi, Dr M. Kamei, Dr H. Haneda* ECG* & PPG/AML/NIMS.

Discussions were held with different groups of NIMS to explore the possibility of extended and more intense interactions to achieve the objectives of NEERI-NIMS research collaboration. It was decided to submit a joint research proposal to funding agencies like NEDO.
THE Central Institute of Medicinal & Aromatic Plants (CIMAP), Lucknow, recently celebrated CIMAP Day. Exhibitions on live plants, products developed by CIMAP based on medicinal and aromatic plants, plants awareness, school for general public including students, development of Khurrum Nagar Ring Road crossing as 'Swasthya Jyoti Vatika', interaction with farmers and women entrepreneurs, special lecture and signing of a memorandum of understanding (MoU) between CIMAP and Govind Ballabh Pant University of Agriculture & Technology (GBPUSA&T), Pantnagar were some of the highlights of the celebrations.

Dr S. P. S. Khanuja, Director, CIMAP, called upon the farmers, especially women, to contribute towards commercial production of quality seeds and propagules of improved varieties, which would facilitate large scale cultivation of economically useful medicinal and aromatic plants in the country. Dr Khanuja said that medicinal and aromatic plants growers could be distinguished as ‘Aush-Krishak’ and that CIMAP would help them to develop as specialty farmers-cum-entrepreneurs.

Earlier, Dr S. P. S. Khanuja welcomed the guests and presented, in brief, the latest achievements of CIMAP. He said, "CIMAP is emerging as the visible greener destination for industry as well as rural sector through its focused research coupled with client-oriented technology development in natural products. The readiness of industry worldwide for the high value products for healthcare and that in turn, generating opportunities among cultivators to go for high value agriculture of resource plant materials is leading towards a technology driven road to sustainable rural development. No doubt, the multidisciplinary approach of team CIMAP is not only making CSIR's impact meaningful to the common man but is also establishing the working models to replicate in the country for effective technology dissemination and bridging the rural-urban gap. The biovillage mission of CIMAP this year enhanced its scope from geranium cultivation in Uttaranchal to Patchouli cultivation in Karnataka and organic farming from Uttar Pradesh to all directions in the country." Dr Khanuja also described the technological output of CIMAP in the form of four varieties of high value plants: Artemisia annua (CIM-Arogya) for antimalarial drug, Mentha piperita (CIM-Indus and CIM-Madhruras) for perfumery to food supplements and pharmaceutical usage and Indian basil (CIM-Saumya) for aromatic oil. "These varieties are the outcome of genetic improvement work by scientific teams at CIMAP to equip the farmers with new options of biotech agriculture," Dr Khanuja added.

Shri S. P. Singh, Municipal Commissioner, Lucknow Nagar Ni-gam, planted a Rudraksha sapling at Khurrum Nagar Crossing which is being developed by CIMAP, as "Swasthya Jyoti", the symbol of participatory conservation.

At the special function to mark CIMAP Day celebration, Dr P. L. Gautam, Vice-Chancellor, GBPUSA&T, delivered the lecture entitled, 'Strategies for Sustainable Agriculture.' He emphasized that agriculture is our culture, and not merely cultivation. We take it as our tradition, he added. He stressed upon the need to adopt diversified cropping system with precision and high-tech, low cost agriculture for sustainable crop production. Dr Gautam pointed out that integrated pest and nutrient management towards organic cultivation is the need of the hour. He added that India has a treasure of biodiversity with respect to different agroclimatic zones, plant species and microorganisms and the same should be catalogued and characterized for utilization. Appreciating the efforts of CIMAP, Dr Gautam said that CIMAP has the responsibility of steering research in medicinal and aromatic plants and making the technologies available to the farmers and entrepreneurs. Dr Gautam also felicitated five scientists: Drs E.V.S. Prakash Rao, L. Rahman, Alok Kalra, A. K. Mathur and Anirban Pal for their performance as recognized by the Research Council. He also released the CIMAP Newsletter, JMAPS and Farm Bulletin on Patchouli both in soft and hard copy formats. Besides, the database developed on multi-drug resistance was also released.

On the occasion an MoU between CIMAP and GBPUSA&T was signed by Dr P. L. Gautam, Vice Chancellor, GBPUSA&T and Dr S. P. S. Khanuja, Director, CIMAP with the common desire to explore, extend and strengthen the functional relationship. The MoU would facilitate the research students/ scientists work-
Announcements

NOMINATIONS INVITED

CSIR Young Scientist Awards for 2005

THE Council of Scientific & Industrial Research (CSIR) invites nominations for the CSIR Young Scientist (YS) Awards for the year 2005. The awards are to be given for research contributions made primarily in India. The age of the nominee should not be more than 35 years as on 26 September 2004. The nominee should be a regular employee of CSIR system holding a post of Scientist ‘B’ or above. He/she should have joined CSIR laboratory on or before 26 September 2004.

The YS Awards are given annually in the following disciplines: (1) Biological Sciences, (2) Chemical Sciences, (3) Earth, Atmosphere, Ocean and Planetary Sciences, (4) Engineering Sciences, and (5) Physical Sciences (including instrumentation). The YS Award carries with it a citation, a plaque and a cash award of Rs.50,000 (Rupees fifty thousand only) for each scientist selected for the Award.

Nominations should be sent to the Head, Human Resource Development (HRD) Group, CSIR Complex, Library Avenue, Pusa, New Delhi 110 012, as per the prescribed pro-forma (20 copies) along with one set of research papers published during the last 5-year period by 31 January 2005. The details of the YS Award and the prescribed pro-forma for nomination can be obtained from the website: http://csirhrdg.res.in

InterRidge Workshop – Tectonic & Oceanic Processes along the Indian Ocean Ridge System (TOP-AIRS)

THE National Institute of Oceanography, Goa will be holding InterRidge Workshop from 19 to 21 January 2005. The workshop will focus on the geological, geochemical, physical, chemical and biological processes at the Indian Ocean spreading centers and provide forum for exchange of ideas and results. One of the major goals of the workshop is to develop a new international collaborative phase of exploration using latest tools and techniques for better understanding of the ridge processes and hydrothermal vent system in the Indian Ocean.

The workshop includes following themes:
- Tectonic and ridge segmentation
- Mantle dynamics
- Evolution of the Andaman backarc basin
- Plume dynamics and deep-sea circulation
- Hydrothermal vent processes
- Biogeochemistry of bottom waters
- Ridge biology
- Emerging technologies in ridge research

For further information please contact:
Dr Abhay Mudholkar/Dr K.A. Kamesh Raju
Convener, TOP-AIRS
National Institute of Oceanography, Dona Paula, Goa – 403 004, India

E-mail: abhay@darya.nio.org/kamesh@darya.nio.org
Phone: +91-832-2450319/2450332
Fax: +91-832-2450602/603/604