MACS

Maharashtra Association for the Cultivation of Science

Agharkar Research Institute

Annual Report 2011-12

Vision

Our goal is to excel as an internationally recognized centre of multi-disciplinary life science research that focuses on industrial development, human health and environment.

Mission

Conduct basic and applied research in life sciences and harness the genetic diversity of microbes, plants and animals towards a cleaner environment, sustainable agriculture and better health of the masses.

National Science Day

Open house/ Science exhibition

27-28 February 2012

Maharashtra Association for the Cultivation of Science

Agharkar Research Institute

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MACS

Annual Report 2011-12

Maharashtra Association for the Cultivation of Science

Agharkar Research Institute

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Administrative Officer, ARI, Member-Secretary

Director

Dr DR Ranade (from July 2010)

Contents

From the Director's Desk

It is indeed a pleasure to present this report which elucidates considerable research developments at the institute. It would be absolutely interesting for me to give you a theme-wise glimpse of these achievements.

Crop improvement : * With the objective of incorporating important traits like leaf rust resistance, grain protein content and yellow pigment content using marker assisted breeding, a number of crosses, in the background of popular varieties have been initiated. A number of polymorphic markers for each parental combination have been identified and are being used for marker assisted background selection. * Durum wheat entry MACS 3828 was tested in final year of AVT for timely sown irrigated conditions in North Western Plain Zone and Central Zone. * Based on the performance of wheat under coordinated trials in different zones, three entries have been promoted to AVT 1st year among which MACS 3817 is being tested in peninsular zone (PZ) as well as central zone (CZ). Fifteen entries have been included in initial varietal trials (NIVT & Spl. Trial Dic.). * In 2011-2012 season, three frontline demonstrations involving 4 farmers were conducted on 3 ha area. The wheat test varieties were MACS 6222 (aestivum) and NIDW 295 (durum). * During current season (2011-12) wheat breeder seed production program was taken on about 10.6 ha area so as to achieve a target of 290 q. * A high yielding soybean variety MACS 1188 has been identified for its cultivation in Southern Zone of India (which includes Maharashtra, Karnataka, Andhra Pradesh and Tamil Nadu) during Annual Group Meeting of All India Coordinated Project on Soybean at Bengaluru in April 2011. * Three MACS soybean lines have performed very well in IVT conducted at Hol Farm. MACS 1364 gave the highest yield of 3983 kg/ha. MACS 1281 recorded maximum seed yield of 4080 kg/ha in AVT I&II conducted at Hol farm followed by MACS 1311, KDS 344, RKS 63 and KS 103 showing significantly higher seed yield than the best check RKS 18 (3411 kg/ha). * Sowing of soybean on 15 June gave maximum seed yield followed by 30 June and 15 July. These dates recorded significantly higher seed yield than sowing at 30 July. * Grape hybrids H-516 as well as ARI – 302 seedless variety are performing well in farmers' fields.

Microbial processes : * Purified and lyophilized antimicrobial compound from *Planococcus maritimus* was characterized. MALDI analysis showed that the molecular weight of the compound was 1.41 kDa which confirms its peptide nature. * Bacterization of wheat seeds with MCM B-866 enhanced seed germination, root and shoot length and biomass of seedlings under stress condition such as high salinity, draught, and heavy metal pollution. * Microbial diversity of formation water samples was investigated by both culture independent as well as by culture dependent approaches. The cultured diversity mainly consisted of genus *Bacillus* and *Geobacillus* belonging to class *Firmicutes* while uncultured diversity revealed the presence of genus *Microbacterium, Pervibacterium* and *Petrobacter* belonging to class *Beta-proteobacteria.* * Test study to validate exogenous enzyme application for enhancement of biomethanation process showed that addition of cellulase alone showed ca. 1.5 fold increase in the methane yield as compared to dual enzyme addition.

Nanobioscience : * A novel concept of using "catalytically inactivated and structurally intact" enzymes as novel "biorecognition elements" has been developed. Based on this concept it was possible to demonstrate that lyzozyme (inactivated at pH 8) could capture Gram positive bacterium, viz., *Staphylococcus aureus*, which is often implicated in bacteremia, deep abscesses, endocarditis, lymphadenitis, and lymphangitis. * 3D circular microfluidics based diagnostics platform capable of multiplexed detection of microorganisms is rapid, sensitive, reliable, less reagent consuming, and cost effective. The present technique also provides an inexpensive yet powerful tool to image and quantify pathogens at low numbers with passage of large sample

volumes. * With the knowledge of the role of zinc in glucose metabolism and insulin secretion, we have reported the blood glucose lowering effects of zinc oxide nanoparticles (ZON) in diabetic rats. Now we report the mechanism of action of ZON based on *in-vitro* experiments using established cell line.

Human nutrition : * Oxidative stress induced by reactive oxygen species (ROS) has been hypothesized to be a principal contributor in Alzheimer's disease (AD). The redox active metal ions iron and copper are found in AD plaques, suggesting that they might mediate ROS generation.

Biodiversity : * Two isolates of anaerobic bacteria from human gut namely BLPYG-7 and NMBHI-10 showed 16S rRNA sequence similarities of 97 % and 96 % respectively with type strain of *Megasphaera elsdenii.* Based on phylogenetic analysis, mole% G+C content, FAME analysis and carbohydrate utilization pattern these isolates could be the novel species of genus *Megasphaera*. * National facility for culture collection of fungi established by DST, Govt. of India provides services to various academic/research institutes in India. The facility also undertakes active research on various aspects of fungal systematics and bioprospecting. * Phylogeny of a new species of *Pseudocercospora* was studied. This taxon was established as *Pseudocercospora kamalii*. * Morphological description of 360 medicinal plants was completed. Medicinal utility of 360 resources occurring in Maharashtra was compiled from literature.

Natural product chemistry : * Secondary metabolites of lichens promised bactericidal activity and the order of the activity of lichen species was found as *Parmotrema nilgherrensis* > *Parmotrema sancti-angelii* > *Cladonia ochrochlora*. * In order to accept herbal medicinal products at global level, Indian Council of Medical Research (ICMR) is publishing monographs of Indian Medicinal Plants following World Health Organization guidelines. Under this sponsored project monographs on quality standards of Indian medicinal plants are being developed by combined efforts of Botany and Chemistry Groups. * The field trials of formulations developed from plant based and pheromone based products for attracting honey bees were carried out on BT cotton (Bunny BG-I and Bunny BG-II) at University of Agricultural Sciences, Dharwad. All the formulations were found to enhance bee visits to the flowers.

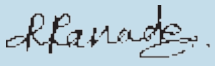
Developmental biology : * With increasing use of hydra as a model system, it was necessary to describe the taxonomic position and phylogenetic relationship of Indian hydra with other species of hydra. This hydra can be classified only as a different strain of the *vulgaris* species, particular to the type locality mentioned, and for further referencing we call it as *H. vulgaris* Ind-Pune.

Palaeobiology and palaeontology : * The decline of mangroves since 3500 yrs BP and further degradation except at Kallada region have been attributed to the prevailing arid climate and weakening of monsoon until 1500 yrs BP. Our observation points to the fact that West Kallada has excellent potential for the rehabilitation of mangroves.

Fifty-eight research papers were published in SCI journals. Twenty-two research papers were published in non-SCI journals. Thirteen candidates earned the PhD degree. Sixty-one sponsored projects were operational. Some of our students won accolades for paper presentation.

Besides research the institute actively organised the National Technology Day, Hindi Day, Vigilance Awareness Programme, and National Science Day. Dr Anil Kakodkar, DAE Homi Bhabha Chair, BARC was invited to deliver a lecture on the occasion of the National Science Day. Dr Kakodkar spoke on 'Preparing for our secure energy future'. The institute organised the DST WOS-B programme. *Shetkari mela* (Farmers' meet), an exhibition of fossils and minerals, popular lectures and articles by institute scientists were the attempts to reach the society.

To summarise, the institute actively involved itself in all the activities with a lot of enthusiasm.



(DR Ranade)
Officiating Director

Date: 21 September 2012
Place: Pune

Crop Improvement

Crop Biotechnology

Mapping of QTL for agronomic traits and kernel characters in durum wheat (*Triticum durum* Desf.)

A genetic linkage map for Indian durum wheat, derived from a cross of durum cultivar PDW-233 with a landrace Bhalegaon-4 was used to map the QTLs for important agronomic traits and kernel characters. A recombinant inbred line population developed from PDW 233 × Bhalegaon 4 cross was analyzed in five environments to understand the genetic network responsible for test weight (TW), thousand kernel weight (TKW), grain yield (YLD), spike length (SL), spikelets per spike (SPS), kernel per spike (KER) and kernel weight per spike (KWS). Genotype, environment and their interactions were main sources of variance for all the traits. TW and TKW were influenced by 11 main effect QTL and 6 digenic epistatic interactions detected on chromosomes 2A, 2B, 4B and 7A. Grain yield was influenced by three epistatic interactions and five main effect QTL, of which two on chromosome 2A were most consistent. A major QTL for spike length was observed on chromosome 3B. QTL for spike characters were distributed over 9 chromosomes. Significant influence of digenic epistasis (*QQ*) and, to a certain extent, QTL × environment interactions (*QQE*) was observed for all the traits. Therefore, while breeding for complex traits like kernel characters and grain yield components, attention should also be given to these interactions. The consistent QTL on chromosome 2A between the marker interval *Xgwm71.2 – Xubc835.4* with pleiotropic effect on TW and TKW, may be utilized in early generation selection to improve TW and TKW and thereby the milling potential of the durum wheat.

Marker assisted breeding

With the objective of incorporating important traits like leaf rust resistance, grain protein content and yellow pigment content using marker assisted breeding, a number of crosses, in the background of popular varieties have been initiated.

Improvement of grain protein content, gluten strength and amylose content in the popular bread wheat varieties of peninsular region namely, NI5439 and MACS2496 and grain protein and yellow pigment content in the durum wheat varieties MACS3125 and HI8498 has been undertaken under accelerated crop improvement programme launched by Department of Biotechnology, New Delhi. In another project, development of biotic stress resistant varieties by incorporating leaf rust resistance genes *Lr*24, *Lr*28 & *Lr*34 and stem rust resistance genes *Sr*2, *Sr*26 and *Sr*36 is targeted.

A number of crosses between donor and recipient parents have been initiated and hybrids backcrossed to respective recurrent parents. The backcrosses are presently at BC_3F_1/ BC_2F_1/ BC_1F_1 stages. The markers linked to these traits have been validated in the different genetic backgrounds for their efficient utilization in foreground selection. A number of polymorphic markers for each parental combination have been identified and are being used for marker assisted background selection.

Accredited test laboratory for quality testing of tissue culture raised plants

Under the National Certification System for Tissue Culture raised Plants (NCS-TCP), the laboratory in the Genetics and Plant Breeding Group has been recognized as accreditated test laboratory (ATL) for quality testing of tissue culture raised plants mainly for banana and sugarcane. The samples of tissue culture raised

plants provided by production facilities are tested for quality (genetic fidelity) using molecular markers. So far, about 300 samples from 10 different companies have been tested.

Plant Tissue Culture

Effect of *agrobacterium rhizogenes* strains on hairy root culture of grapes for production of secondary metabolites

Three *Agrobacterium rhizogenes* strains: ATCC 15834, LBA 9402 and MTCC 532 were used for hairy root induction in grape hybrids. Results showed high number of hairy root formation by ATCC 15834 and LBA 9402. Stem and leaf explants were tested for hairy root formation. Infection frequency was highest in stem explants infected with LBA 9402 strain (**Figure 1**). Effect of phenolic acetosyringone was studied and 150-200 µM was found to be the optimum concentration for hairy root formation.

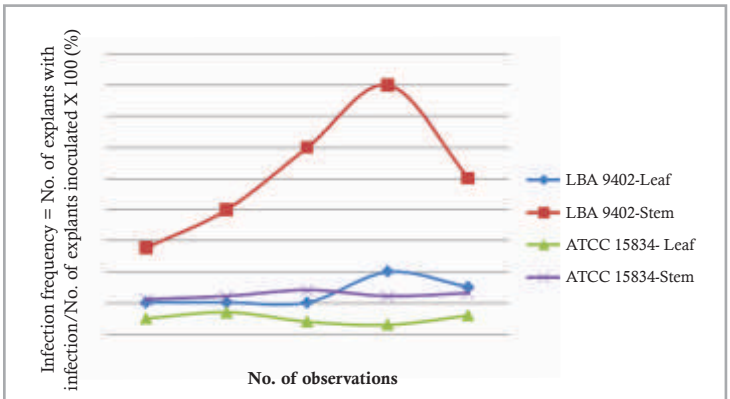


Figure 1 Effect of different strains- ATCC 15834 and LBA 9402 on infection frequency of stem and leaf explants. Highest infection frequency was observed in stem explants infected with LBA 9402

Wheat Improvement

The Institute is one of the centers of ICAR, New Delhi for implementing All India Coordinated Wheat Improvement Projects. Wheat research at ARI is aimed at developing high yielding, disease resistant wheat varieties particularly of durum wheat for India in general and peninsular zone in particular. Work on aestivum wheat and dicoccum wheat is also carried out with specific objectives. Production of breeder seed is done as entrusted by ICAR/Central or State Government. Institute is also engaged in dissemination of latest technology of wheat production directly on farmers field.

Salient features of 2011-12 crop season

Durum wheat entry MACS 3828 was tested in final year of AVT for timely sown irrigated conditions in North Western Plain Zone and Central Zone.

Co-ordinated Programme

Based on the performance under coordinated trials in different zones, three entries have been promoted to AVT 1st year among which MACS 3817 is being tested in PZ as well as CZ. Fifteen entries have been included in initial varietal trials (NIVT & Spl.Trial Dic.) further testing (Table 1A & 1B).

Apart from this, two augmented trials as well as 13 nurseries including EIGN-II, YCSN, QCSN, DHTSN, NGSN, ESWYT, IDYN, SAWYT, EBWYT, IBWSN, IDSN, CWANA-4th SRR FA/IR –SBWYT and NBPGR were conducted at Hol farm (Table 2).

Station Trials

During 2010-11, total 347 entries were evaluated under replicated station trials of which 11 were significantly superior to checks and 112 entries were observed under 1st non-significant group (Table 3).

During current season 2011-12, about 379 cultures were tested under replicated station trials of which 167 were durums, 167 aestivums and 45 dicoccum. Of these 124 were under rainfed conditions and rest under irrigated timely sown conditions. In augmented trials, 187 entries were tested under rainfed trials and 452 entries under irrigated trials.

Table 1A Promotions of wheat entries from NIVT to AVT 1st year

Entry	Trial	Zone	Remarks
MACS 6478	AVT-IR-TS-TAD	PZ	2nd rank in NIVT 2 with constituting 1st non significant group in PZ
MACS 3817 (d)	AVT-IR-TS-TAD	PZ	3rd rank in NIVT 4 (PZ) and 5th rank at National level with constituting 1st non significant group
MACS 3817 (d)	AVT-IR-TS-TAD	CZ	1st rank in NIVT 4 (CZ) and 5th rank at national level with constituting 1st non significant group
MACS 3828* (d)	AVT-IR-TS-TDM	NWPZ	3rd rank at zonal mean with high yielding over all the checks
MACS 3828* (d)	AVT-IR-TS-TDM	CZ	3rd rank in CZ with constituting 1st non significant group in PZ
MACS 5012	SPL-DIC-IR-TS	All Zones	2nd rank at zonal mean with high yielding over all the checks

Table 1B New wheat entries under NIVT's

Entries	Trial	Entries	Trial
MACS 6531	NIVT 2	MACS 3912	NIVT 5B
MACS 6583	NIVT 2	MACS 3914	NIVT 5B
MACS 3929	NIVT 4	MACS 3915	NIVT 5B
MACS 3895	NIVT 4	MACS 3863	NIVT 5B
MACS 3892	NIVT 4	MACS 6412	IVT-RIR-HF-TAS-SHZ
MACS 6566	NIVT 5A	MACS 6530	IVT-RIR-HF-TAS-SHZ
MACS 6568	NIVT 5A	MACS 5008	Special Trial (Dic.)
		MACS 5022	Special Trial (Dic.)

Table 2 Nurseries conducted at Hol farm

Station Trials (Non- replicated)	Total number of cultures	Nursery	Total number of cultures
Augmented RF durum	78	EIGN- II	60+2
Augumented RF aestivum	109	DHTSN	98
Augmented HF durum	265	CIMMYT	972
Augmented HFaest.	122	NBPGR Trial	1179+4
Augmented HFDic.	65	NGSN	97+5
		QCSN	52+3
		YCSN	130
Total	**639**	**Total**	**2588**

Table 3 Performance of wheat entries tested under station trials

Trial	Total number of cultures	Significantly superior cultures	Cultures in 1st non-significant group
APT RF	50	1	14
APT HF	105	0	46
Small Scale Trials RF	72	4	15
Small Scale Trial HF	120	6	37
Total	**347**	**11**	**112**

Breeding programme

During 2011-12 season, 191 crosses were attempted. These include 109 single (straight) crosses and 82 back and three way crosses. Of these 109 straight crosses, 76 were among aestivums, 28 durums and 5 dicoccum. For breeding programme under irrigated and rainfed conditions, uniform progenies were bulked in F5/F6/F7 generation. On the basis of plant type and rust reactions and grain quality, 1764 progenies and 625 bulks were retained (Table 4).

Table 4 Wheat breeding program at ARI

Description	Generation	Breeding material sown during 2011-12		Selections made for 2012-13		bulks made
		Crosses sown	Progenies retained	Crosses retained	Progenies sown	
Rainfed *T. durum*	F_7-F_3	86	352	58	471	146
Rainfed *T. aestivum*	F_6-F_3	59	236	46	267	105
Irrigated *T. dicoccum*	F_7-F_4	12	93	12	39	50
T. durum	F_7-F_3	96	560	96	430	44
T. aestivum	F_7-F_3	158	699	139	557	280
Total		**411**	**1940**	**351**	**351**	**625**

Multilocational germplasm evaluation (NBPGR)

ARI is a part of multilocational evaluation of wheat germplasm for agronomic traits and biotic stress. About 10200 accessions received from National Bureau of Plant Genetic Resources (NBPGR) since 2004 have been evaluated. During 2011-12, a total of 1179 accessions were planted for evaluation and data were collected on 18 agronomical traits. Pathological observations were recorded for leaf rust and stem rust. Data has been collected and harvesting of trial completed. A total of 188 cultures were resistant to black rust and 121 cultures were resistant to brown rust, whereas 364 were resistant to both the rusts.

Grain samples collection from market for quality and pathological investigations

About 46 wheat grain samples collected from Pune, Satara, and Ahmednagar districts from various mandies, farmers field were sent to Karnal for quality and disease analysis of Karnal bunt, black point, yellow berries etc. in harvested grains.

Frontline demonstrations on farmers' fields

Frontline demonstrations are being conducted on farmers' fields to evaluate the impact of latest improved varieties over the previously released/old varieties. This programme has been sponsored by Ministry of Agriculture, Govt. of India. During 2010-11 season, seven front line demonstrations were conducted (Table 5). In 2011-2012 season, three frontline demonstrations involving 4 farmers were conducted on 3 ha area. the test varieties were MACS 6222 (aestivum) and NIDW 295 (durum).

Table 5 Yield performance (q/ha) of test entries against checks in FLDs during 2010-11

Sr. No.	Test Variety	Check Variety	% Increase over check
1	MACS 6222 (34.50)	RAJ 4037 (33.00)	4.55
2	MACS 6222 (37.97)	NIAW 917 (34.17)	10.97
3	MACS 6222 (32.00)	GW 322 (30.00)	6.67
4	HI 8663 (36.30)	MACS 3125 (31.00)	16.94
Average	**35.19**	**32.04**	**9.83**

Breeder seed programme

About 360 quintals of breeder seed was produced and sold to different agencies for 2011 rabi season (Table 6). During current season (2011-12) breeder seed production program was taken on about 10.6 ha area so as to achieve a target of 290 q.

Table 6 Wheat Breeder seed sold during 2011-12

Wheat Variety	Breeder Seed Sold during 2011-12 (q)	Breeder Seed targeted for 2012-13
MACS 2496	95	115
MACS 3125	25	48
MACS 6145	3	2
MACS 6222	112	14
HD 2189	116	100
Lok 1	12	-
MACS 2971	-	10
TOTAL	**363**	**289**

Improvement of leaf rust resistance to bread wheat variety MACS 2496 and initiatives for probable threat against pathotype Ug99

Fifteen F_1 involving MACS 2496 for rust improvement were backcrossed with MACS 2496 and also with HW 2002, HW 2004, FLW 5 (Lr24 + Sr 24), FLW 6 (Lr9 + Sr 24), FLW 8 (Lr19 + Sr 25), Hybrid 65 and Pavan which are resistant to Ug99. Seven fresh cross combinations using resistant donors for Ug99 and leaf rust were attempted.

Crossing programme was continued for improvement of leaf rust resistance to bread wheat variety MACS 2496. On the basis of rust reaction and yield data three cultures have been included in IRSN and 12 cultures are in advanced station trials.

Indo-Australian project on root and establishment traits for greater water use efficiency in wheat

During season 2010-11, trial comprising of forty wheat cultivars of Indian origin were sown in single hill plot at two different sowing times (Timely and Late) with three replications at Hol Farm. Under rain fed condition, HW 2004, HD 4672, C 306, HI 1531, HD 2781, LOK -1, HI 8627 and NI 5439 showed a good combination of

plant height, tiller number, yield, biomass, harvest index, early flowering and maturity, stay green habit, chlorophyll at anthesis and at harvest and PBW 550, WH 1021, DBW 14, HW 2044, RAJ 4083, NIAW 34 and HUW 234 recorded high Canopy Temperature Depression (CTD) at Pre Flowering (PF), Flowering (F) and Near Grain Filling (NFG) stages.

Under restricted irrigation condition, NI 5439, HW 2004, HD 2888, B.YELLOW, HD 4672 and C 306 showed a good combination of plant height, tiller number, yield, biomass, harvest index, early flowering and maturity, stay green habit, chlorophyll at anthesis and at harvest and HI 8627, HW 2044, RAJ 3765, NW 2036, NIAW 34, WH 1021 and RAJ 4083 recorded high CTD at PF, F and NGF stage.

Interestingly varieties like, C 306, HI 8627, LOK -1, HD 4672, HD 2733 and WH 1021 showed a stable performance for all the traits under rainfed as well as restricted condition, which make them ideal for growing under these environments.

Generating new wheat germplasm with enhanced drought or heat tolerance using AB genomes genetic diversity (Generation Challenge Programme)

Main objective of the project is to combine novel genes for drought and heat tolerance using tetraploid diversity in wheat and related germplasm.

Primary synthetic wheat varieties received from CIMMYT were used for intercrossing between durum based synthetics and dicoccum based synthetics at our research farm and 40 cross combinations were made. Selected plants from F_4 generation were crossed with elite bread wheat varieties and physio-morphological observations were recorded. Cross seed was sown at Wellington to raise F1 and subsequently at Hol to raise F2. In addition, about 700 out of 1008 DH populations involving synthetic wheat and promising Indian bread wheat lines developed in PBI, Sydney under this project have been received through DWR, Karnal for their evaluation and distribution to Indian breeders.

A world collection of 250 emmer wheat accessions from diverse origins was phenotyped for morpho-physiological traits for third year at Hol farm. Besides this, a set of 82 newly synthesized synthetic wheats developed under this project in CIMMYT involving diverse dicoccum lines from global collection and *Ae. tauschi* were received for their evaluation under drought and heat tolerance and use in wheat improvement.

Yield components and physiological attributes in wheat under water stressed conditions

Study was carried out with the objective of screening wheat germplasm for yield components and physiological parameters and understanding relationship between them. Bread wheat germplasm comprising a set of 42 Indian wheat genotypes and another set of 146 wheat lines from CIMMYT was studied for days to heading (DH), days to maturity (DM), grain yield, thousand kernel weight (TKW), canopy temperature depression (CTD, normalized difference vegetation index (NDVI) and chlorophyll content (SPAD value) under rainfed conditions. CIMMYT germplasm showed wider range for grain yield and CTD than Indian wheats. CIMMYT genotypes 9628, 9616 and 9698 constituted 1st non-significant group for grain yield, CTD, NDVI and TKW. CIMMYT germplasm showed significant positive correlation between grain yield and DH, TKW, CTD and NDVI. Positive correlation was also observed between TKW and DH, DM as well as SPAD. Among the Indian wheats studied, HD 2781, RAC 875, MACS 6222 and HI 1580 constituted 1st non-significant group for grain yield, CTD, NDVI and SPAD.

Soybean Improvement

Soybean [*Glycine max* (L.) Merrill] is often called as a wonder bean, as it is the cheapest source of vegetable proteins (40-43%) with its nutritionally good seed oil (18-20%) as a by-product. It occupies first place among the oilseed crops of India covering an area of 10.3 million hectares and production of 12.6 million tonnes. Maharashtra State ranks second with respect to area, production and productivity of soybean. Soybean research at ARI is done by keeping the following main objectives in view: i) to develop high yielding varieties with early to

mid-late maturity, high oil content, better seed quality, seed germination, resistance to diseases and pests, and nonshattering pod habit, ii) to develop production technology for maximization of yield, iii) to produce sufficient quantities of nucleus and breeder seed of MACS varieties for supplying to seed multiplication agencies, iv) transfer of improved technology to farmers' field and v) improvement of soybean seed quality.

Identification of soybean variety – MACS 1188

A high yielding soybean variety MACS 1188 has been identified for its cultivation in Southern Zone of India (which includes Maharashtra, Karnataka, Andhra Pradesh and Tamil Nadu states) during Annual Group Meeting of All India Coordinated Project on Soybean at Bengaluru in April 2011. This variety gave the highest average seed yield of 2475 kg/ha in coordinated trials conducted in 2008-10 (Figure 2). This variety is also resistant to major insect pests and diseases of soybean and resistant to pod shattering habit.

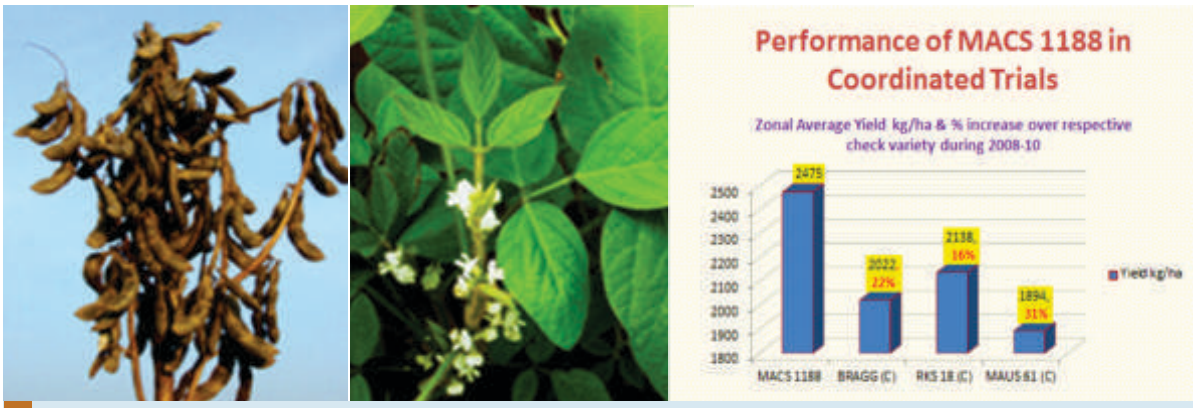


Figure 2 Newly identified high yielding soybean variety MACS 1188

Screening for high oil content and earliness

Segregating material consisting of progenies in F_2-F_6 generation was screened using NMR. The superior individual plant selections with more than 20% oil content were retained and sown in *kharif* 2011 season. 26 MACS soybean lines showed more than 20% oil content out of 53 such lines included in yield evaluation trials during *kharif* 2011. MACS 1434 showed the maximum oil content of 21.66 %. From segregating material consisting of progenies in F_3-F_6 generations, 542 early maturing (up to 80 days) single plant selections were made.

Station trials

During *kharif* 2011 season, 53 new elite breeding lines of MACS were tested in four graded replicated trials. Out of these 24 lines gave significantly more yield than the highest yielding control JS 335. Performance of elite breeding lines has been presented in Table 7.

Table7 Performance of MACS lines in station trials

Trial Category	No. of lines tested	No. of lines with >20% oil content	No. of lines with significantly higher yield than best check JS 335
Preliminary Row Trial	24	7	11
Advanced Plot Trial	11	7	3
Large Scale Trial (2 Groups)	18	12	10
Total	**64**	**26**	**24**

Evaluation in All India Co-ordinated Trials

On the basis of superior performance at different centers in respective zones, MACS 1340 was promoted to AVT-I in Southern and North Eastern Zone whereas MACS 1311 and MACS 1336 were promoted to AVT-II of Southern and North Eastern Zones, respectively. Three MACS lines, viz. MACS 1340, MACS 1364 and MACS 1366 were evaluated in Initial Varietal Trial (IVT) across the Zones (Five zones) in India during *kharif* 2011 season. All the three MACS lines have performed very well in IVT conducted at Hol Farm. MACS 1364 gave the highest yield of 3983 kg/ha. MACS 1281 recorded maximum seed yield of 4080 kg/ha in AVT I&II conducted at Hol farm followed by MACS 1311, KDS 344, RKS 63 and KS 103 showing significantly higher seed yield than the best check RKS 18 (3411 kg/ha).

Development of Kunitz trypsin inhibitor free soybean varieties

Two released popular soybean varieties viz. MACS 450 and JS 93-05 were selected for introduction of null allele for Kunitz trypsin inhibitor. A trypsin inhibitor free line PI-542044 was used as source of null allele. Hybridization was done between MACS 450, JS 93-05 and PI 542044. BC_1 generations of both the crosses were raised after identification and crosses with the F1 plants last year. Parental varieties and donor line were screened with 155 SSR markers to see the parental polymorphism. In case of MACS 450 seventy primers were polymorphic and in case of JS 93-05, 100 primers were polymorphic which will be ultimately used for background selection for genome recovery of recipient parents.

Agronomy research

In evaluation of AVT II entries for optimum plant population trial, three plant populations (0.30, 0.45 and 0.60 million plants/ha) showed significant differences. 0.30 million plants/ha recorded significantly higher seed yield (2230 kg/ha) than 0.60 million plants/ha (1957 kg/ha) and was at par with 0.45 million plants/ha (2280 kg/ha). MAUS 61 recorded maximum average seed yield of (2341 kg/ha) followed by MACS 1281 (2183 kg/ha).

100% organic management produced significantly higher seed yield than 100 % inorganic management and 50 % organic + 50 % inorganic management system. During *rabi* 2011-12, wheat with 100% inorganic management system produced significantly higher soybean equivalent yield, net returns and B:C ratio.

65 and 75 kg/ha seed rates gave higher seed yield than 55kg seed rate /ha and were at par with each other. RKS 18 gave significantly higher yield than MAUS 61.

Protective irrigation at flowering and seed initiation stage proved to be beneficial for enhancing soybean yield (Figure 3).

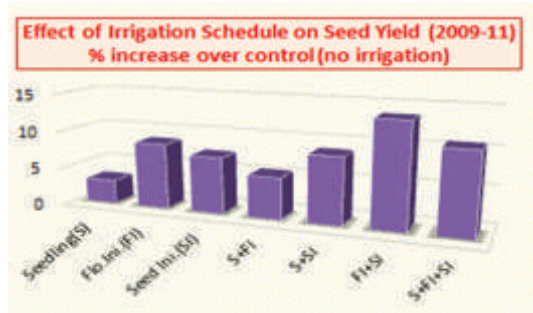


Figure 3 Effect of irrigation schedule on seed yield of soybean

Sowing of soybean on 15th June gave maximum seed yield followed by 30th June and 15th July. These dates recorded significantly higher seed yield than sowing at 30th July.

MACS 1281 with 100% recommended fertilizer doze (RFD) produced higher seed yield (2173 kg/ha) than other varieties with different levels of nutrition i.e. 75% RFD and 125% RFD.

Entomology research

Results of entomology experiments indicated low to moderate infestation of stem fly and tobacco caterpillar at the Institute's research farm at Hol. Categorization of the AVT test entries for resistance against stem fly revealed CSB 08-09, JS(SH) 2003-8, MACS 1311, KS 103, CSB 08-08, DSb 20 and MAUS 453 to be highly

resistant to stem fly. On the basis of visual observations on defoliation MACS 1364 was categorized as resistant and twelve entries viz. MACS 1340, JS 20-35, SL 900, NRC 89, VLS 81, JS 20-38, PS 1503, Himso 1681, MAUS 608, JS 20-41, PS 1505 & RKS 68 were moderately resistant to tobacco caterpillar. Twenty entries were categorized as resistant high yielding (R-HY) entries and six entries were susceptible high yielding (S-HY, tolerant) entries on the basis of Maximin-minimax method. No significant effect of variable spray volumes on insect damage was observed. However, among insecticides Trizophos and Rynaxypyre were found to be effective against stem fly and tobacco caterpillar, respectively. Among nine soybean genotypes evaluated G14P15, H2P2, H5P19 and L1P29 were early maturing genotypes maturing within 80 days. FS 02-2 Sel. 3, G4P15 and H5P19 were resistant to stem fly. H5P19 recorded the least leaf damage due to tobacco caterpillar followed by G4P15.

Nucleus and Breeder Seed Production

Nucleus and breeder seed production programme of MACS varieties was undertaken to produce good quality seed for supply to seed multiplication agencies in Maharashtra as well as in other states. During the year, 54.4 quintals breeder seed of MACS 450 (7.50 qtls.), JS 335 (134.7 qtls.) and JS 93-05 (3.00 qtls.) were supplied to different public and private seed multiplying agencies and private farmers (Table 8).

Table 8 Nucleus and breeder seed production

Variety	Nucleus seed (qtls.)	Breeder seed (qtls.)	
		Allocated (qtls.)	Produced (qtls.)
MACS-13	0.09	----	----
MACS 57	0.16	----	----
MACS-58	0.21	----	----
MACS-124	0.15	----	----
MACS-450	2.09	12.00	9.90
JS 335	5.00	100.00	81.00
JS 93-05	1.10	----	----
Total	**8.80**	**112.00**	**90.90**

Similarly, a total of 1410 superior single plants and 195 uniform bulks (Nucleus stage-I) of Monetta, MACS 13, MACS 57, MACS 58, MACS 124, MACS 450, JS 335 and JS 93-05 were selected for production of nucleus seed during *kharif* 2012 season.

Frontline demonstrations (FLD)

Nine frontline demonstrations were conducted on farmers' fields in Baramati taluka, Dist. Pune to evaluate the impact of improved technology (IT) over farmers' practice (FP) using MACS 450, RKS 18, PK 1029, MAUS 61 and MACS 57 soybean varieties. Adoption of improved technology (2392 kg/ha) increased soybean yield compared to farmers' practice (1851 kg/ha) by 29.23% and gave additional net returns of Rs. 5658/ha.

Grape Improvement

Collection of 17 wild-types was made from Karwar area. *Ampelocissus* (5 species), *Cayratia* (2 species), *Cissus* (4 species) and *Leea* (6 species) were collected in August 2011. Morphological variation within the species was observed in the collection from different locations.

Photographs of all phenological stages are being captured. The digitalized data is organized in specially designed format called Haritarium. (*Harit* – Green and *arium* is House or storing place). The content of the format is divided in two basic units at present. Unit one contains taxonomic description, chromosome number, information regarding chemical content, medicinal uses, localities, etc. Unit two contains photographic information of habitat, habit, inflorescence, flowering, fruits, seeds, bracts, dorsal and ventral views of leaves, key characters, etc. Ecological aspects and association studies are in progress. Such studies are not available. This could be a valuable reference for plant researchers who are involved in taxonomy, conservation and medicinal plants. Haritarium data for 8 *Leea* species is completed.

Visits to farmers' fields were arranged to examine the performance of hybrids developed by ARI and study various cultivation practices used by them. H-516 as well as ARI – 302 seedless variety are performing well in farmers' fields.

In hybridization programme, twenty seven cross combinations were attempted and 195 F_1 hybrid seedlings were raised in 2010-11. Intra-specific and inter-specific crosses were undertaken to introduce desirable fruit qualities and disease resistance in grape hybrids and varieties. Total twenty seven cross combinations were attempted using eight cultivars and nine existing hybrids as female parents. Ninety four panicles were emasculated and pollinated from which 815 berries were harvested with 1124 seeds. Pollens of Thompson seedless, Flame Seedless, H-228 and H-516 were used to pollinate eight cultivars and nine hybrids for direct and back crosses during this season.

Out of sixteen (16) hybrids evaluated for their fruit quality, two hybrids showed high TSS, two hybrids showed superior performance for berry length. Only one hybrid H- 228 (Catawba x Calzin) performed better for bunch weight, high TSS and pH of the juice. Though H-246 (Anab-e-Shahi x Catawba) is good yielder having bold seeds, its bunch maturity is uneven**.** Three cultivars and six hybrids were also evaluated to explore the possibility of taking off-season crop. Uneven maturity was observed in all hybrids and varieties. Though TSS ranged from 8.6 to 14.0 ^{0}Brix, the taste was acidic. Suitability for wine making may be explored further.

For the benefit of marginal grape growers, research work for production of grape wine using partial chaptalization method is underway. Cabernet Souvignon, Sharad Seedless for red wine and Souvignon Blanc for white wine are being used in this programme. This process is being standardized at room temperature to help farmers for producing quality wines at very less cost.

Microbial Processes

Biodegradation of nitroexplosives

The nitroexplosives and their intermediate products are toxic, hence their removal from environment is imperative. The studies were carried out on biodegradation of two nitroexplosives namely Triaminotrinitrobenzene (TATB) and Diaminodinitroethylene (FOX-7) developed by HEMRL, Pune, DRDO, Govt. of India.

Three isolates utilizing TATB namely *Enterobacter cloacae complex* (TA2), *Escherichia hermannii* (T40) and *Streptomyces* sp. (T16) were able to grow in amination wastewater and reduce COD by 30 – 50% from initial 2000 mg/l.

Streptomyces sp. (F12), *Streptomyces* sp. (F4) and *Corynebacterium* sp. (F13) showed removal of FOX-7 by 58%, 40% and 26% respectively from initial concentration of 500 mg/l FOX-7. Isolate F 12 was found to evolve CO_2 as an end product of degradation of FOX-7. The soil isolate of *Sphingomonas* sp. was found to be the most efficient in removing FOX-7 from the wastewater.

The enzyme nitroreductase was demonstrated to be present in these organisms and involved in reduction of nitro groups of these nitroexplosives.

Bioaugmentation process for treatment of wastewater from Common Effluent Treatment Plant (CETP) to reduce COD and ammoniacal nitrogen

Enviro Technologies Ltd. (ETL), Ankleshwar has a Central Effluent Treatment Plant (CETP) containing wastewater of heterogeneous composition, having COD >7000 mg/l and ammoniacal nitrogen >1000 mg/l.

For treatment of the wastewater, 20% consortium of highly efficient (H), moderately efficient (M) and microbial cultures isolated by ARI (A) in 2:1:1 (v/v/v) was used in batch mode operation at 5 L scale which resulted in 27-81% reduction in COD from initial 5000 mg/l. The reactor using this consortium operated in continuous mode for 15 days, resulted in 29-84% reduction in COD from the initial value of 4307 mg/l (Figure 4).

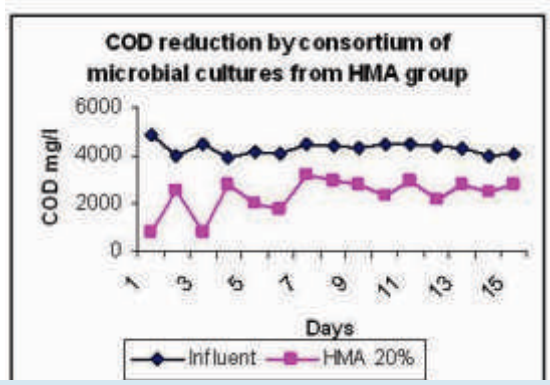


Figure 4 Removal of COD by microbial consortium comprising of HMA group of microorganisms in the 5 L bioreactor operated in continuous mode

Treatment of CETP wastewater using ≥2% activated carbon resulted in 40-52% removal in COD from the initial value of 8800 mg/l and complete removal of original dark brown colour.

Development of blends and composites based on biodegradable polymer of microbial origin

Moderately haloalkalitolerant bacterium *Halomonas campisalis* was earlier reported to produce Polyhydroxyalkanoates (PHA) and the copolymer was found to be biodegradable.

Considering the cost of production, cheap and easily available substrate like table sugar was used. Production of PHA from *H. campisalis* by using 1% table sugar as the substrate was carried out in 14 L SS fermenter with working volume of 8L, at pH 9.5. The dry cell weight of 11.39 g was obtained with PHA content as 47.75%. The results thus showed that table sugar could be used as a substrate for the production of PHA thereby reducing the cost of production.

Biodegradability testing of PHA / PHA-Optim blends / Optim films was carried out by ASTM method based on evolution of CO_2 and soil burial method. Samples of blends of PHA with optim (70:30, 50:50) and optim film provided by NCL, Pune were tested for biodegradability using consortium of *Micrococcus lylae*, *Bacillus subtilis* and *Halomonas campisalis*. Biodegradability of all these samples was indicated by CO_2 evolution from 3rd week of incubation. Biodegradability testing of the above samples was also carried out by soil burial method for 14 weeks. The loss in weight indicated only marginal biodegradability of PHA blends with optim (Figure 5).

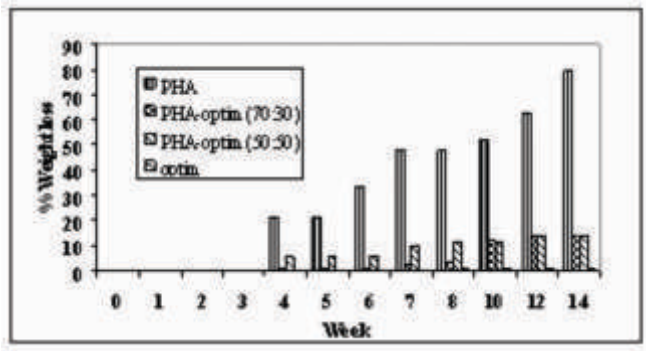


Figure 5 Biodegradability testing using soil burial method based on % weight loss in PHA and PHA blends

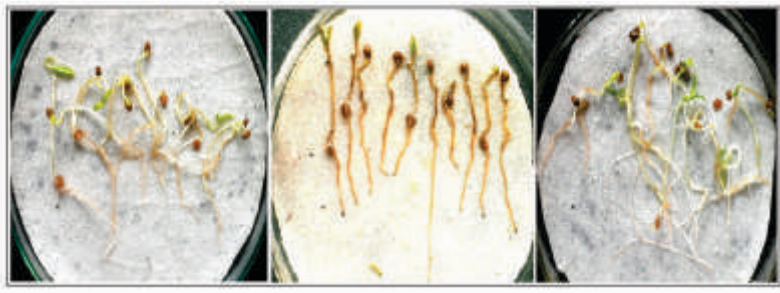
Production of PHA by haloarchaea

Inoculum optimization experiment was set up for production of PHA using 0.5%, 1%, 2%, 5%, 10% and 20% inoculum of initial inoculum density of 10^8 cells/ml in PHA accumulation medium at 37°C for 7 days. Optimum inoculum was found out to be 10% (v/v) for the production of PHA by haloarchaea.

Studies on production of antimicrobial compounds from alkaliphilic bacteria isolated from Lonar Lake

Purified and lyophilized antimicrobial compound from *Planococcus maritimus* was characterized. Melting point of the compound was around 202°C and elemental analysis of the pure compound revealed presence of Carbon (49.67%), Hydrogen (7.375%), Nitrogen (15.58%) and Sulphur (2.026%). MALDI analysis showed that the molecular weight of the compound was 1.41 kDa which confirms its peptide nature.

To confirm antifungal activity, the culture filtrate of *P. maritimus* was assessed for its ability to control the root rot disease on tomato plants caused by *Fusarium oxysporum* using a new method, which simulates in vivo conditions. The broth filtrate of *P. maritimus* showed good control of an infection of *Fusarium oxysporum* on the tomato roots (Figure 6).



a (Positive control) b (Negative control) c (Test)

Figure 6 The efficiency of the culture filtrate of *P. maritimus* in control of the root rot disease on tomato plant caused by *Fusariumoxysporum*. a, b and c shows germinated seeds without exposed with fungal disc (positive control), exposed with fungal disc (negative control) and exposed with fungal disc and culture filtrate of *P. maritimus* (test)

Microbial production of collagenase and its applications

Stenotrophomonas sp. and *Bergeyella* sp. were reported to produce enzyme collagenase having application in generation of value added products like low molecular weight peptides and hydroxyproline.

The collagenase produced by *Stenotrophomonas* sp. could hydrolyze collagen rich wastes from different sources to generate peptides of different sizes. 302 mg % of small peptides (3-10 kDa) within 2 h of incubation of 1.2 U/ml of crude collagenase and 244 mg % of hydroxyproline within 6 h of incubation with 2.4 U/ml of crude collagenase were obtained from 1.5 % fish collagen stock. Recovery of small peptides was 20% and of hydroxyproline was 16 % on stock (collagen) weight basis. The low molecular weight peptides have applications in Pharma and cosmetic products.

The collagenase was tested for its toxicity through dermal route in Wistar rats and rabbits. The collagenase of the present study is found to be safe to use with its dermal LD50 greater than 2000 mg/kg body weight. The dermal irritation /corrosion test of the collagenase was carried out by applying the enzyme to shaven back of three female rabbits at intact and abaded sites for consecutive days. A total irrittaion score of the collagenase on the rabbits was 0.00 indicating that the enzyme is non-irritant to the skin in rabbits.

Pharmacological aspects of 'Actinokinase'

The efficacy evaluation of the fibrinolytic enzyme 'Actinokinase' isolated and characterized earlier from thermophilic *Streptomyces* sp. was carried out.

The enzyme was produced in 2.5 L fermenter for successive 5 - 6 batches. The fibrinolytic enzyme was purified using column chromatography. The crude enzyme and purified samples were kept at 4 ^{0}C for stability study and analyzed at different intervals of time on SDS-PAGE and by activity assay. Both the crude and purified enzymes were stable and retained the activity for 6 months.

The structural changes during fibrinolysis were studied using Phase Contrast microscopy. The fibrin degradation products (FDP) and D-dimer products are released and measured using the immunospecific tests and it was supported with the microscopic observations. D-dimers were also observed under phase contrast microscopy (Figure 7). Actinokinase enzyme doesn't cleave the fibrinogen and does not affect the blood protein components. It also rules out the bleeding complications which are commonly observed in the reported thrombolytic agents.

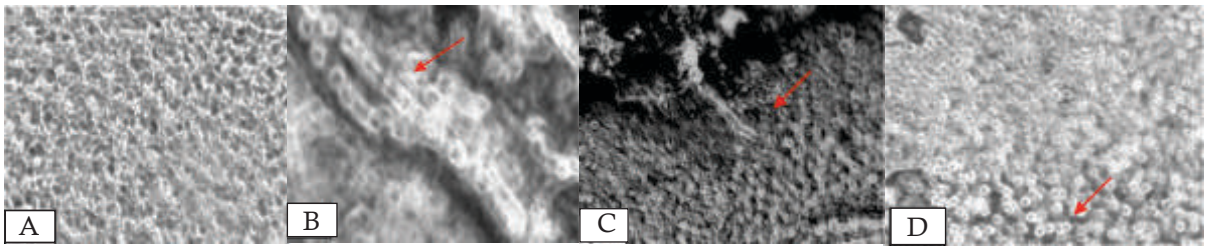


Figure 7 Phase contrast microscopy photographs of fibrin clot lysis using Actinokinase enzyme A) Control fibrin B) lysis at 10 min', arrow shows the lysis point C) lysis at 20 min D) lysis at 30 min

Acinetobacter calcoaceticus promotes Wheat Plant Growth under Abiotic Stress

Abiotic stresses like drought, salinity and heavy metal contamination in agricultural lands hamper crop yield world wide. In the present investigation, a multi-stress tolerant and plant growth promoting strain MCM B-866 (an isolate from wheat rhizosphere) was identified as *Acinetobacter calcoaceticus* on the basis of 16SrRNA gene sequencing (Genbank accession no. JF683588) (Figure 8). MCM B-866 possessed several plant growth promoting traits such as production of siderophore, phytohormones (indole acetic acid, gibberllin and salicylic acid), and ACC deaminase; solubilisation of inorganic-/ organic phosphate and zinc oxide.

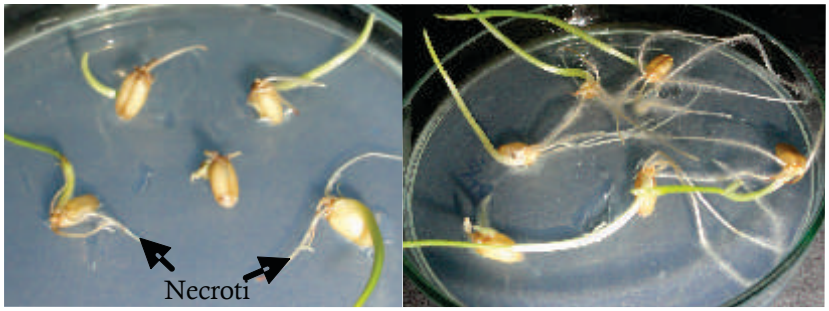


Figure 8 Mitigation of heavy metal stress in seeds bacterized with MCM B-866
a) Control (un-bacterized) seedlings – stunted root growth and necrotic lesions on root tips ; b) Bacterized seedlings – healthier roots

Bacterization of wheat seeds with MCM B-866 enhanced seed germination, root and shoot length and biomass of seedlings under stress condition such as high salinity, draught, and heavy metal pollution. Lowered stress subsequent to bacterization was evident from decreased proline concentration, higher antioxidant activity and higher relative water content. Moreover stress signs such as necrotic lesions and stunted root growth were conspicuous in their absence in bacterized seedlings unlike unbacterized control. Pot experiments performed using alkaline, drought prone, infertile and metal rich soil confirmed MCM B-866 mediated plant growth promotion of wheat crop (Table 9) even under abiotic stress.

Table 9 Green House Study: Effect of inoculation of wheat seeds with *Acinetobactercalcoaceticus* MCM B-866 on growth and yield of wheat on maturity of plant

Growth Parameter	Control	Bacterial treatment	Percent increase(%)	Standard error	LSD * (P< 0.05)
Root length (cm)	8.97	9.47	5.57*	1.26	2.292019
Shoot length (cm)	29.72	37.55	26.35*	1.89	3.438028
Grain yield (mg/plant)	366	570	55.74*	7.59	13.75211
100 grain weight (g)	4.25	6.35	49.42*	1.06	3.510785

* LSD- Least Significant Difference, *Significant - different from the control for P < 0.05

Cloning and expression of *P. aeruginosa* HHP01 hydantoinase for the improved synthesis of optically pure amino acids

Optically pure unnatural amino acids are extensively used for the production of semi-synthetic antibiotics, peptides, hormones, pyrethroids, pesticides as well as in pharmaceuticals and developmental drugs. Synthesis of optically pure amino acids using enantioselective hydantoinase is considered as a breakthrough technology owing to the several advantages it offers over conventional chemical process. However, only a limited number of hydantoinases have been commercially exploited due to their narrow substrate range, limited stability at high temperature or in

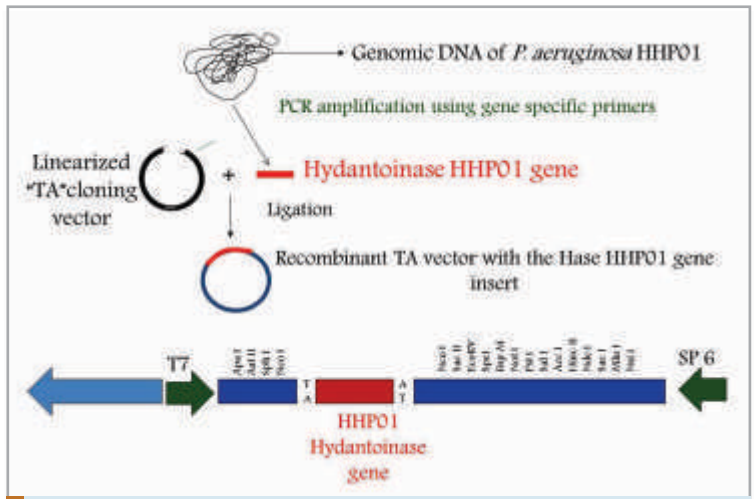


Figure 9 Pictorial representation of the cloning procedure

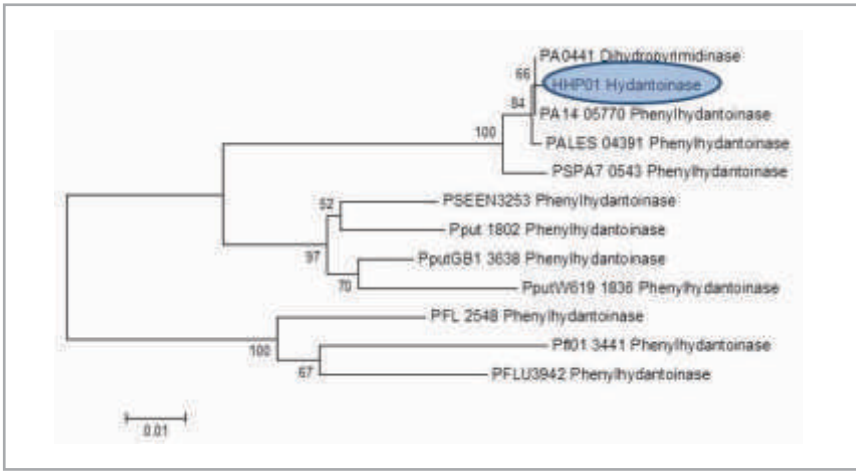


Figure 10 Phylogenetic tree showing the relationship of HHP01 hydantoinase and other reported hydantoinase and related enzymes

organic solvents and low yields. In the present investigation, we have reported *P. aeruginosa* HHP01 hydantoinase enzyme with desired properties such as enantioselectivity, broad substrate range and active at higher temperature and alkaline pH. Hydantoinase yield in its wild host under optimized condition was ca. 1000 U/ L. To further improve the yield, genes encoding hydantoinase in HHP01 strain were cloned and expressed in *E. coli* (Figures 9&10).

Process optimization for expression of soluble recombinant hydantoinase

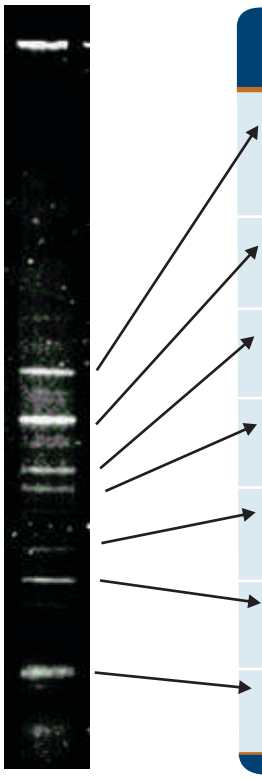
Various parameters influencing the expression of recombinant hydantoinase such as choice of host, temperature, IPTG concentration, length of induction, growth phase, etc. were optimized. It was found that maximum hydantoinase expression was achieved when culture was induced at an O.D of ~0.6 with IPTG concentration of 100µM for more than 12 hrs. More than 150% increase in the yield of hydantoinase enzyme was achieved with recombinant strain as compared to the optimized expression of the same in the wild host HHP01.

Exploration of pristine and extreme habitats for novel thermophiles

Microbial diversity constitutes the most extraordinary reservoir of life in the biosphere which is yet to be completely explored and understood. The subsurface oil reservoirs are the habitats that are away from the human intervention and considered as an ideal niche that can inhabit a wide range of taxonomically diverse microorganisms capable of producing industrially important bio-molecules. In the present study, microbial diversity of formation water samples was investigated by both culture independent as well as by culture dependent approaches. The uncultured diversity was studied using PCR-DGGE approach. Total seven species/strains were identified on the basis of 16S rRNA gene partial sequencing (Figure 11).

30 formation water isolates were identified and characterized on the basis of partial 16S rRNA gene sequence and biochemical characterization. A total of 10 aerobic, thermophilic, spore-forming bacteria were isolated in pure cultures at 60 °C. Of these isolates the putative positive strains were identified using Polyphasic identification approach. The strain designated FW23- a novel member of genus *Geobacillus* was identified on the basis of its morphological characters, Scanning electron micrographs, biochemical characterization, 16S rRNA sequencing, gyrB gene sequencing, cellular fatty acid methyl ester analysis and DNA-relatedness. The DNA-DNA hybridization studies consolidated ours findings that isolate FW23 exists as a novel species within the genus *Geobacillus* (Figures 12,13; Table 10).

The cultured diversity mainly consisted of genus *Bacillus* and *Geobacillus* belonging to class *Firmicutes* while uncultured diversity revealed the presence of genus *Microbacterium, Pervibacterium* and *Petrobacter* belonging to class *Beta-proteobacteria.*



DGGE BAND NO.	Closest Phylogenetic affiliate	% Homology
N1	Uncultured bacterium isolate DGGE band B14 16S ribosomal RNA gene, partial sequence	96 %
N2	Microbacterium sp. THWCSN33 16S ribosomal RNA gene, partial sequence	87 %
N3	Uncultured Parvibaculum sp. partial 16S rRNA gene, clone P2RS76	90 %
N4	Parvibaculum lavamentivorans DS-1, complete genome	90 %
N5	Microbacterium sp. VTT E-073040 16S ribosomal RNA gene, partial sequence	75 %
N6	Petrobacter sp. Clone_AER 16S ribosomal RNA gene, partial sequence	97 %
N7	Uncultured bacterium clone SSW62Au 16S ribosomal RNA gene, partial sequence	98 %

Figure 11 16S rRNA gene partial sequencing

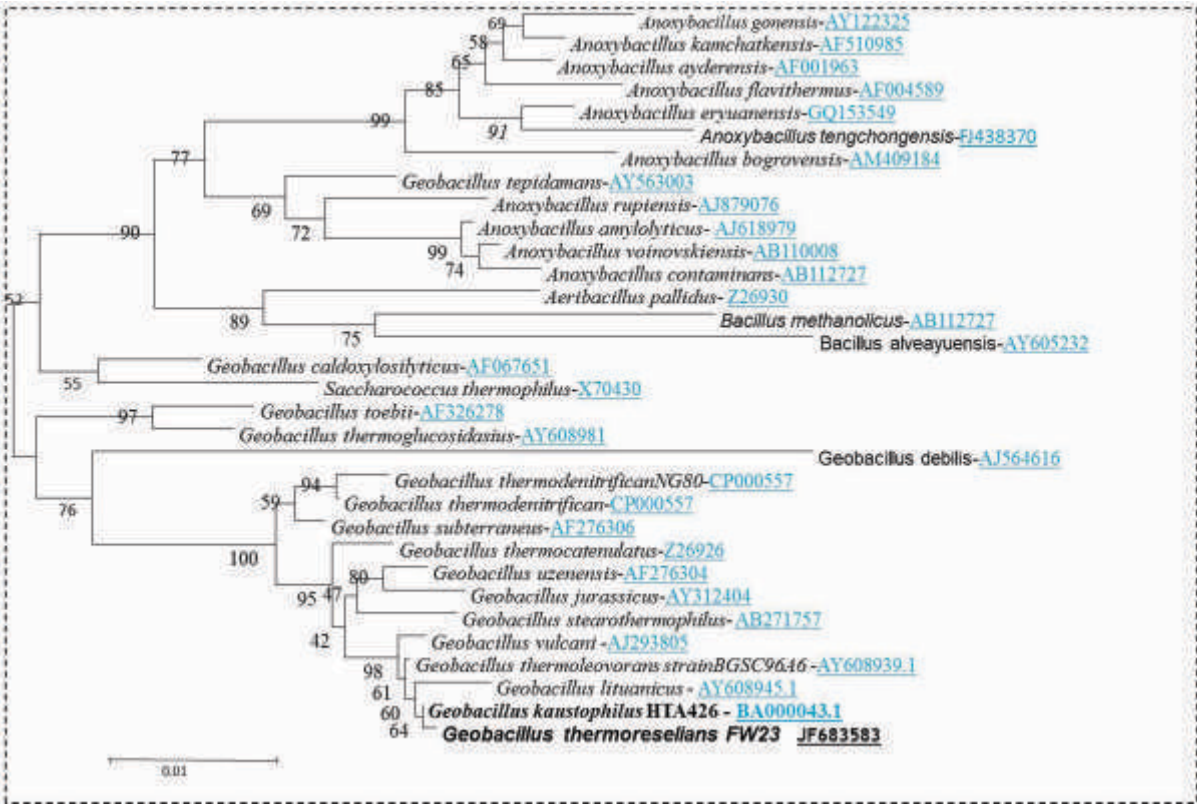


Figure 12 Molecular phylogeny

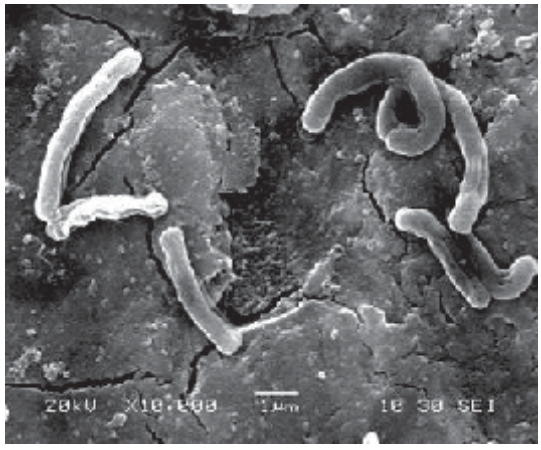


Figure 13 SEM micrograph of FW 23

Table 10 FAME profile

Fatty acid	Ref	FW23
12:00 cyclo	6.1	2.81
14:0 myristic acid	3.0	8.74
15:0 isopentadecanoic	24.3	16.88
16:0 isopalmitic acid	ND	ND
16:0 cyclopalmitic acid	2.52	26.0
17:0 isoheptadecanoic	28.2	8.70
17:0 anteisoheptad	ND	ND

Anaerobic Processes

Novel microbial processes have been standardized for the production of hydrogen and butanol from distillery waste. Possibility of patenting these will be explored.

Test study to validate exogenous enzyme application for enhancement of biomethanation process

Studies were carried out to validate the effect of enzyme addition on anaerobic digestion of vegetable waste in batch experiments. It was found that enzyme addition leads to enhancement of biomethane yield from the hotel waste (food, vegetable residues) during batch anaerobic digestion. Addition of cellulase alone showed ca. 1.5 fold increase in the methane yield as compared to dual enzyme addition (Table 11) Since the present study was conducted using enzymes procured only from a single source, it would be inappropriate to conclude

Table 11 Effect of enzyme addition on anaerobic digestion of vegetable waste in 2L batch scale digesters

Parameters	Control	Cellulase (T1)	Cellulase (T2)	Control	Xylanase (T1)	Xylanase (T2)	Xylanase+ Cellulase (T1)	Xylanase+ Cellulase (T2)
Period of digestion (days)	13	13	13	18	18	18	18	18
Working volume of digester (mL)	1200	1200	1200	1200	1200	1200	1200	1200
F/M ratio	1:10	1:10	1:10	1:10	1:10	1:10	1:10	1:10
pH variation	7.17 - 7.92	7.09 - 8.08	7.18 - 8.17	7.02- 7.83	7.08- 7.99	7.15- 7.98	7.20- 8.04	7.13- 7.93
Total Biogas (ml)	5440± 799	6070 ± 99	6028 ± 421	8353± 216	7428± 357	7495± 262	7830± 431	7403± 647
Maximum CH_4 (%)*	55	57	54	59	60	59	62	62
Total carbohydrates reduced (g glucose equivalent)	3.16	3.15	2.87	0.67	0.91	1.13	1.18	1.24
Reducing sugars accumulation (g of sugars)	0.31	0.31	0.29	0.23	0.41	0.49	0.58	0.42
CH_4 yield (ml g^{-1} VS utilized)	2038 ± 623	3039 ± 167	2894 ± 321	2137± 223	2057± 272	2387± 453	2964± 216	2496± 244

#T1 – Vegetable waste with enzyme added directly to digester; T2 – Vegetable waste pretreated with enzyme for 1 h prior to addition to digester * Methane % is reported for biogas measured by water displacement method. Biogas was analysed on Gas chromatograph. Methane % calculated using standard methane factor. Headspace methane of the anaerobic bottle in which expts were carried out is not added in the calculation of total methane.

the ultimate fold increase in methane yield. The ultimate effect of the enzyme (cellulase) on the methane yield in 25 L digester needs to be studied for a longer period.

Investigation of metabolic pathway regulations and process optimization for crude glycerol bioconversion to high value chemicals

With the growing demand for renewable energy sources, production of biodiesel is expected to go up many folds. Deoiled cake and crude glycerol are two major wastes generated in biodiesel production. With a view to develop a bioprocess for producing industrial chemical 1,3-propanediol (1,3 PDO), butanol etc., isolation and screening program was initiated. Enrichments were set up from four different samples including effluent from vegetable digester, soil samples around oil mill waste treatment plant and temples where spillage of oil takes place frequently.

Through enrichment and isolation 17 isolates of obligate anaerobic bacteria growing on glycerol and producing 1,3 PDO were obtained. Through two tier screening program for 1,3 PDO production three isolates namely LLS6, O2a and D3 were selected for further studies. All the isolates grew best at 10 g glycerol/ L medium. Isolate D3 showed least production of other metabolites with 1,3 PDO production and hence was selected for further work. Glycerol utilization and 1,3 PDO yield (mol/ mol glycerol utilized) was better under anaerobic conditions as compared with aerobic conditions. Effect of static and shaking conditions on fermentation of glycerol was studied. The yield of 1,3 PDO in terms of g/ g glycerol consumed was almost same (range 0.50-0.59 g/ g) under static and shake culture conditions. This suggests the possibility of using concentration more than 60 g glycerol per litre medium and for higher yield a higher concentration would be better (Table 12).

Table 12 Glycerol utilization and 1,3 PDO production by isolate D3 under anaerobic static and anaerobic shaking conditions

	Static conditions			Shaking conditions		
Glycerol concentration (g/ l)	20	40	60	20	40	60
Glycerol utilized (g)	9.19	11.50	13.33	13.67	16.09	18.66
1,3 PDO production (g/ l)	5.49	6.36	7.81	8.07	8.95	10.09

Nanobioscience

Realizing the importance of Nanotechnology a separate group was established at ARI during the XIth five-year plan. The focus of activities carried out is in the following niche areas with reference to the objective i.e. nanobiotechnology for the improvement of agriculture, human health and environment. Projects such as

Disposable On-Chip PCR

Devices for the rapid detection of pathogen

Microfabricated systems for detection of food contaminants

Rapid identification and antibiotic susceptibility testing of clinical isolates

Nanocarriers for enzymes and siRNA delivery to control plant pests and pathogens

Treatment of cancer by targeted hyperthermia

Interaction of nanoparticles with cultured animal cells

have already been initiated.

Significant scientific achievements in some of these projects during 2011-12 are being presented in the report.

"Catalytically inactivated and structurally intact" enzymes as novel biorecognition elements

A novel concept of using "catalytically inactivated and structurally intact" enzymes as novel "biorecognition elements" has been developed. Based on this concept it was possible to demonstrate that lyzozyme (inactivated at pH 8) could capture Gram positive bacterium, viz., *Staphylococcus aureus*, which is often implicated in bacteremia, deep abscesses, endocarditis, lymphadenitis, and lymphangitis. The new concept has a vast potential in a variety of applications employing molecular recognition.

Additional proof in support of the concept i.e. use of "catalytically inactivated and structurally intact" enzymes for substrate recognition was provided using Molecular Dynamics (MD) simulation. The method is useful for investigating the physical movements of atoms and molecules and is like a "virtual microscope" with high temporal and spatial resolution. The simulation software and data analysis softwares were Amber11 and VMD respectively. Simulations were carried out with hen egg white lysozyme (HEWL) and N-Acetyl glucosamine hexamer $(GlcNAc)_6$ as substrate at pH 6 and pH 8. Data on the protonation states confirmed deprotonation of ASP52 residue at pH 6 and deprotonation of both ASP 52 and GLU 35 residues at pH 8, accompanied by change in orientation of GLU35 residue at pH 8 (which probably resulted in enzyme inactivation). Interestingly, at pH 8, when the enzyme was "catalytically inactive but structurally intact" 16 different residues were involved in stabilization of hexasaccharide and the enzyme-substrate complex was more stable at pH 8 than that at pH 6. Table 13 shows protonation states of active site amino acids at (a) pH 6 (b) pH 8. Figure 14(a&b) represents modeled interaction of hexasaccharide substrate within active site HEWL at (a) pH 6 and (b) pH 8.

3D circular microfluidics based diagnostics platform capable of multiplexed detection of microorganisms

Diseases due to enteric pathogens have a tremendous impact on public health and rapid and timely detection of such pathogens is a necessity. Therefore the aim is to develop rapid, reliable, small and portable

Table 13(a) Protonation states at pH 6

Amino acid	Offset	Predicted	Experimental	Transitions
Glu 07	-1.801	-1.801	2.85	728
His 15	-0.376	-0.376	5.71	29129
Asp 18	-2.391	-2.391	2.66	32
Glu 35	-2.215	-2.215	6.2	46
Asp 48	-3.22	-3.22	2.5	66
Asp 52	-Inf	-Inf	3.68	0
Asp 66	-Inf	-Inf	2	0
Asp 87	-3.341	-3.341	2.07	40
Asp 101	-4.13	-4.13	4.09	6
Asp 119	-2.108	-2.108	3.2	477

Table 13(b) Protonation states at pH 8

Amino acid	Offset	Predicted	Experimental	Transitions
Glu 07	-3.68	4.32	2.85	2.85
Lys 13	1.714	9.714	10.5	10.5
Asp 18	-2.495	5.505	2.66	2.66
Lys 33	1.329	9.329	10.6	10.6
Glu 35	-Inf	-Inf	6.2	6.2
Asp 48	-Inf	-Inf	2.5	2.5
Asp 52	-Inf	-Inf	3.68	3.68
Asp 66	-Inf	-Inf	2	2
Asp 87	-Inf	-Inf	2.07	2.07
Lys 96	1.59	9.59	10.8	10.8
Lys 97	1.735	9.735	10.3	10.3
Asp 101	-Inf	-Inf	4.09	4.09
Lys 116	2.235	10.235	10.4	10.4
Asp 119	-2.439	5.561	3.2	3.2

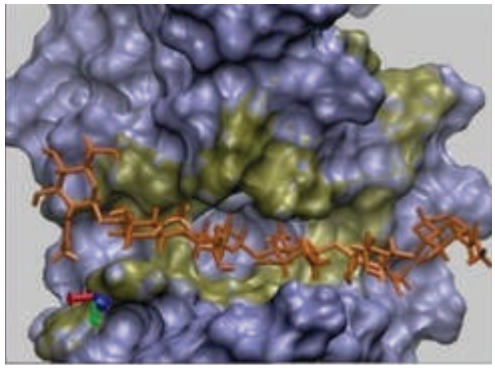


Figure 14(a) Active site hexasaccharide interactions (H bonds) pH 6.0

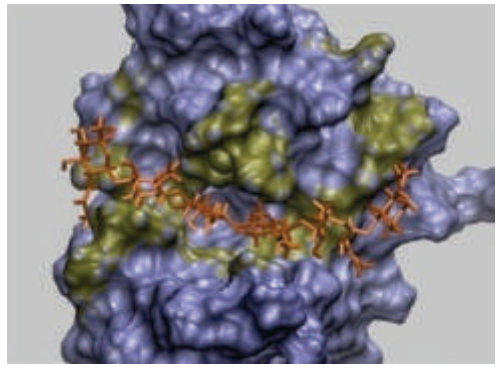


Figure 14(b) Active site hexasaccharide interactions (H bonds) pH 8.0

immunosensors which can be used for simultaneous detection of multiple pathogenic organisms from water samples. Development of such immunosensors in microfluidic platforms would help in achieving this goal.

Poly (dimethyl siloxane) (PDMS) based chips are most commonly used in microfluidic systems to achieve the goal of lab-on-a-chip. PDMS is a versatile material exhibiting properties such as elastomeric nature, optical transparency (230–700 nm), chemical inertness, biocompatibility, permeability to gases and amenability to fabrication via rapid prototyping. It is also a low-cost material that is amenable to micromolding and therefore suitable for preparation of prototype devices. We have already developed procedures for fabrication of microchannels using microdimensional copper wires in PDMS.

Figure 15 Chip used for multiplexing of waterborne bacteria

We have now demonstrated an effective method of Fe_3O_4 magnetic nanoparticles (MNPs) and quantum dot (QD)-based immunoassay for the separation, pre-concentration and detection of two bacterial species viz., *Salmonella typhimurium* and *Escherichia coli* as representative food borne pathogens. This method is based on multiplexed microfluidic technology. In this method microchannels are fabricated in PDMS using simple one-step method which is straightforward, easy, fast, and repeatable. Figure 15 shows the chip for multiplexed detection. A schematic of the detection method is shown in Figure 16. Simultaneous detection of *E. coli* and *S. typhimurium* (from samples containing both species in 1:1 ratio) was possible when the respective detecting antibodies were labeled with two types of QDs (green and red). Different cell densities of *E. coli* and *S. typhimurium* ranging from 10^3-10^7 cfu/mL were detected using the MNP pre-concentration technique in the microchannel. Figure 17(a&b) show the high contrast fluorescence images for both the bacteria while Figure 18 shows quantitative data on correlation of fluorescence intensity and cell numbers. Thus, the method is rapid, sensitive, reliable, less reagent consuming, and cost effective. The study opens up many possibilities of use of microchannels for bacterial detection and is likely to lead to development of inexpensive methods for screening a variety of clinical, water, food, and environmental samples for multiple organisms. The present technique also provides an inexpensive yet powerful tool to image and quantify pathogens at low numbers with passage of large sample volumes.

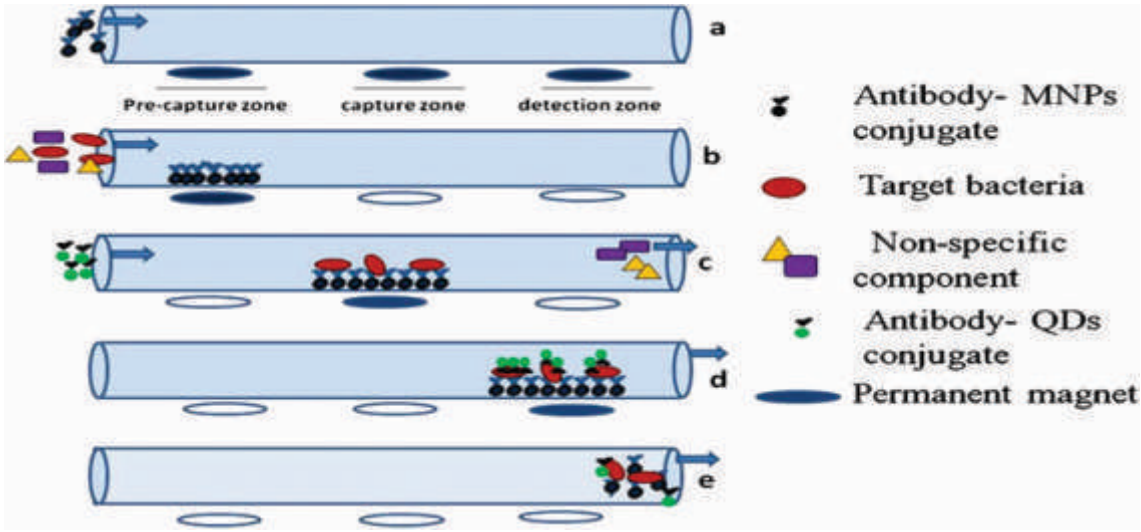


Figure 16 Schematic representation of immunoassay: a entrapment of antibody-conjugated MNP with the help of embedded permanent magnet (field strength 0.3 T); b and c capture of target antigen; d detection of captured antigen with quantum dot antibody conjugate; and e regeneration of channels

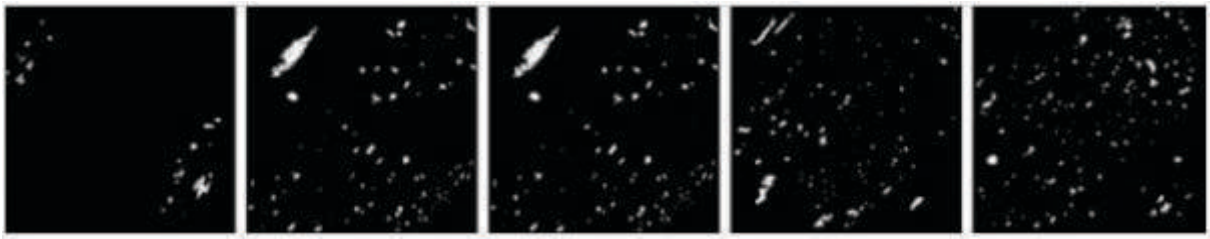


Figure17(a) High contrast fluorescence images of different E. coli densities captured by magnet at detection zone

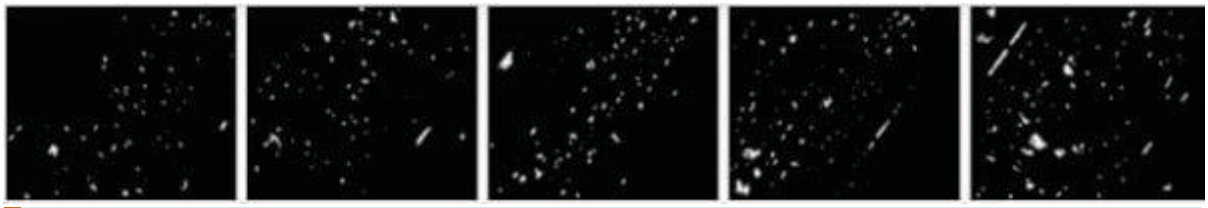


Figure 17(b) High contrast fluorescence images of different S. typhimurium densities captured by magnet in detection zone

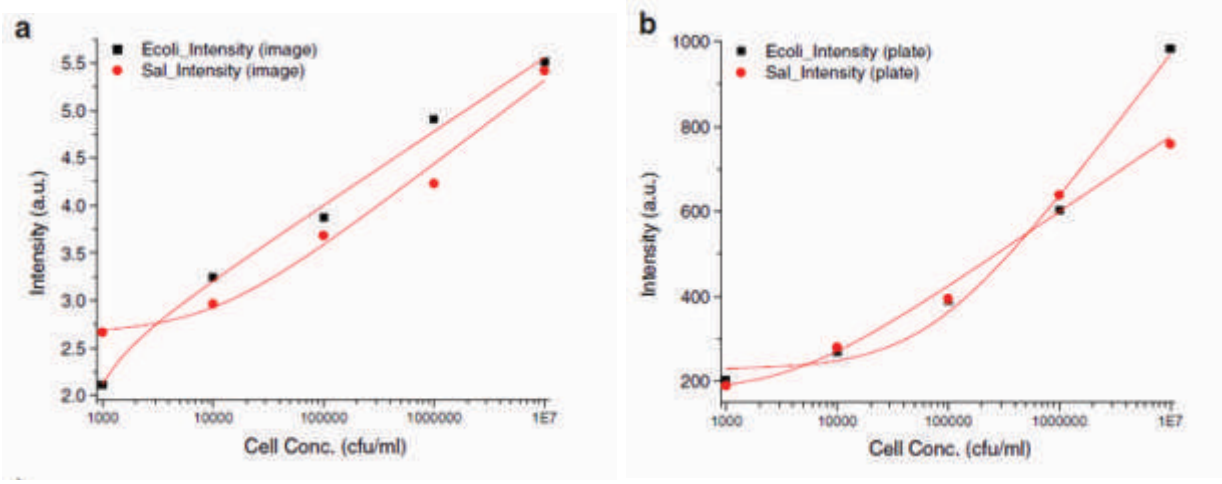


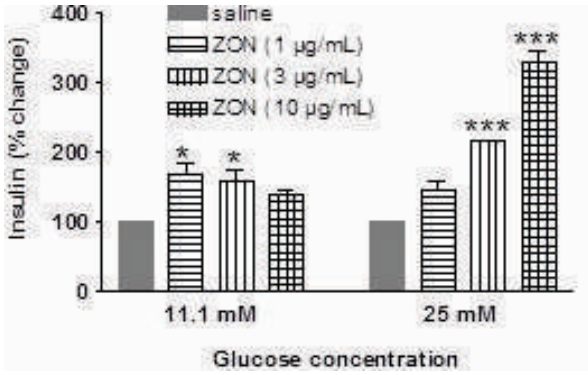
Figure18 Graph showing fluorescence intensity variation with cell density for two different bacteria (*E. coli* and *S.typhimurium*): a data capturedfrom images and b from fluorimeter

Antidiabetic activity of zinc oxide nanoparticles

With the knowledge of the role of zinc in glucose metabolism and insulin secretion, we have reported the blood glucose lowering effects of zinc oxide nanoparticles (ZON) in diabetic rats. Oral administration of ZON for 4 weeks to type 1 and type 2 diabetic rats resulted in reduction of blood glucose levels, improvement of glucose tolerance, increase in serum insulin levels and reduction of serum triglycerides and free fatty acid levels. Single dose pharmacokinetic studies demonstrated that ZON preferentially accumulated in the liver, adipose and pancreas; the important organs for regulation of blood glucose levels. Now we report the mechanism of action of ZON based on *in-vitro* experiments using established cell line.

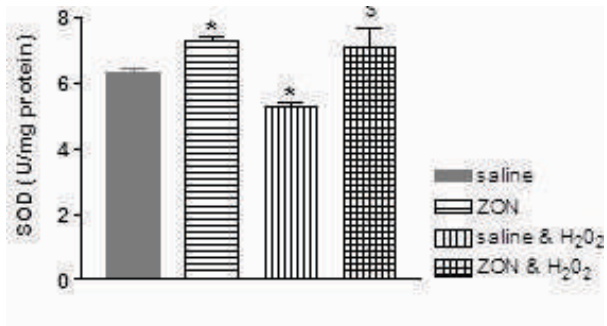
The mechanism of action of zinc oxide nanoparticles was investigated in Rat insulinoma (RIN5f) cells incubated with ZON for 4 h and insulin secretion assessed at low and high glucose concentrations. At glucose

concentration of 11.1 mM, insulin secretion by RIN5f cells was more or less constant at different doses of ZON (Figure 19). However, with glucose stimulation (25 mM), increase in insulin secretion was commensurate to ZON dose suggesting dose- and glucose- dependent effects on insulin secretion. When cellular superoxide dismutase (SOD) activity of control and ZON treated cells was estimated in the presence and absence of oxidative stress (challenge with H_2O_2), ZON treatment *per se* enhanced the SOD activity in RIN5f cells (Figure 20). Under oxidative stress the enhancement in SOD activity was more pronounced with ZON treatment. These results suggest that insulin secretion and enhancement of SOD activity (which protects against oxidative stress) are few of the many possible mechanisms of anti-diabetic action of ZON.



Significantly different from control, *p<0.05, ***p<0.001

Figure 19 Insulin secretion from RIN5f cells at different glucose concentrations



Significantly different from saline control (*) and H2O2 control ($), p<0.05

Figure 20 SOD activity of RIN5f cells

Human Nutrition in Health and Disease

Role Of Maternal Dietary Calcium In Relation To Non-communicable Diseases (ncds) Risks In Adult Offspring

Increased calcium intake appears to lower blood pressure levels among children and pregnant women especially those with habitually low calcium intake. Maternal nutritional intake during pregnancy may have important consequences for long term health in the offspring. Very few experimental data exists on intergenerational influence of calcium intake during pregnancy on offspring cardiovascular risk. Therefore, the effect of maternal supplementation of calcium (as calcium carbonate and as dairy calcium) on pregnancy outcome, growth and risks of NCDs in adult offspring (3 months) was studied.

Growth performance of the offspring born to the dams fed on three experimental diet groups viz. Group I (providing AIN93 diet with 0.4%, suboptimal calcium), Group II (providing high-Ca (1.2% Ca from calcium carbonate), and Group III (providing high-Ca (1.2% Ca from non-fat dairy milk, i.e. milk powder) were compared (Figure 21). The male offsprings from Group II had lower mean body weights than offsprings from Group I and the offspring from Group III had lowest body weights resulting in significant ($p<0.05$) decreasing trend up to 8 weeks. The growth curve of the female offsprings was lower than that of male offsprings in all the groups. There was, however, no significant difference between groups in female pups.

The comparison of systolic blood pressure levels of the offsprings born to the dams fed on the three experimental diets (Figure 22) showed that the mean blood pressure level in Group I, was significantly ($p<0.001$) lowered in Group II, which further decreased in Group III. The results suggest that high dietary Ca (1.2%) to dams throughout pregnancy significantly lowered the blood pressure in the adult offsprings and the high Ca through milk exerted further reduction. Thus the study provided the *in vivo* evidence that high dietary Ca and milk/ dairy intake during pregnancy has intergenerational influence on blood pressure of the off springs.

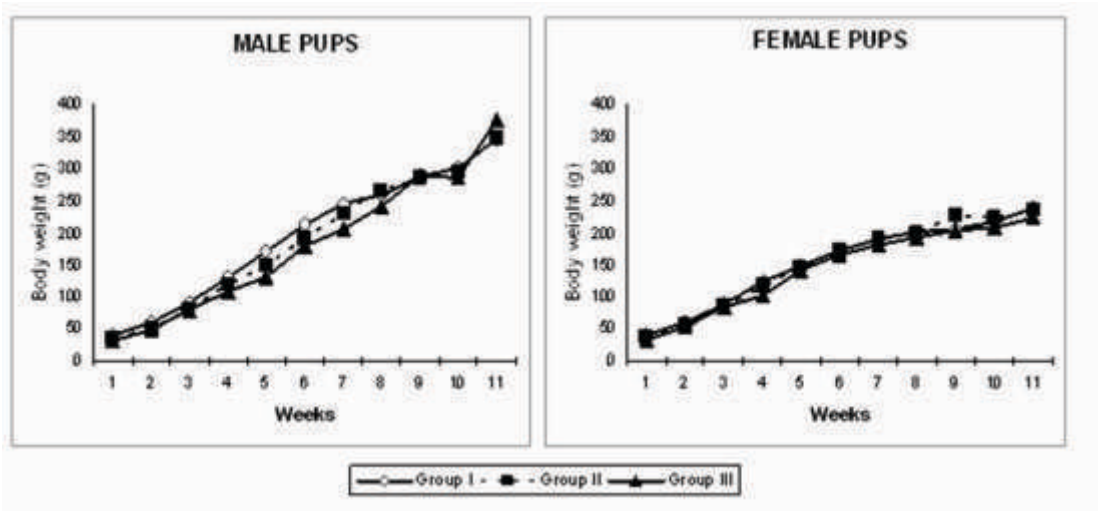
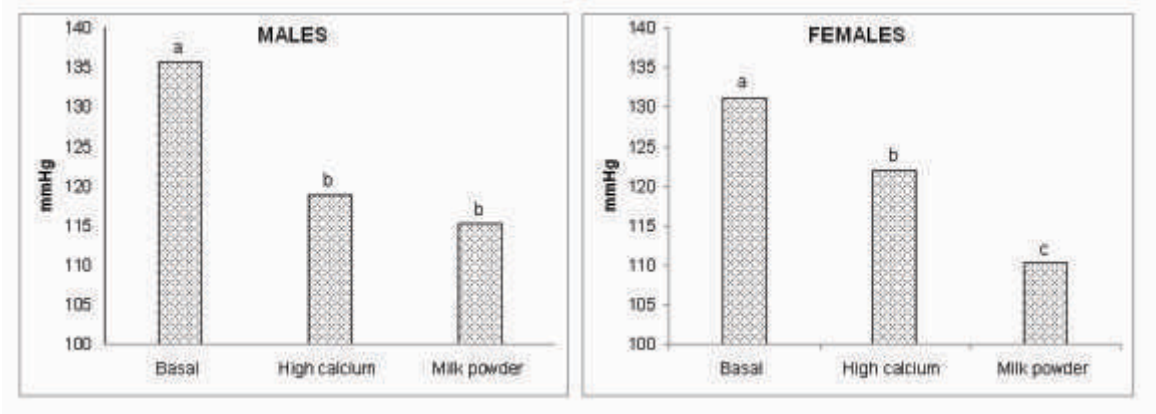


Figure 21 Growth curves of offspring during three months in different groups



Means without a common letter differ, p<0.001

Figure 22 Effect of maternal calcium supplementation on blood pressure levels of the rat pups at 90 days

Functional Foods For Diabetes: Evaluation Of Oral Hypoglycemic Proteins From *Costus Speciosus* (Koenig), Insulin Plant (Pushkarmula) From Western Ghats Of India

Plants are used through several generations for their medicinal properties including diabetes. *C. speciosus, C. igneus and C. pictus* belongs to the family Costaceae, popularly known as insulin plant is cultivated in the coastal area of the Uttar Kannada district of Karnataka. In this area, people consume traditionally few leaves of this plant twice a day for the management of diabetes. In this study, the insulin like protein has been purified from fresh leaves of *Costus plants.* The purity of the protein was checked using SDS-PAGE analysis(Figure 23) . The insulin like activity of protein was established in insulin responsive cell line RIN 5f (Figure 24).

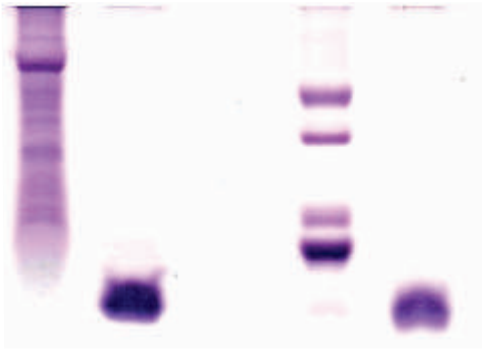


Figure 23 SDS-PAGE analysis of purified protein. Lane 1, Crude extract, Lane 2, Insulin (positive control), Lane 3, molecular weight marker, Lane 4, purified protein

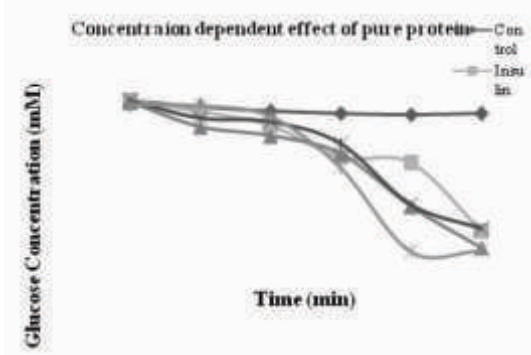


Figure 24 Hypoglycemic property of the protein in *in vitro* bioassay

Role Of Copper In Alzheimer's Disease

Alzheimer's disease (AD) is the most common neurodegenerative disease which affects 10% of humans by age 65 and around 50% by age 85. AD is characterized by a progressive cognitive decline that has been attributed to the deposition of extracellular protein plaques containing the amyloid-β (Aβ) peptide. Copper is implicated in the *in vitro* formation and toxicity of Alzheimer's disease amyloid plaques containing the

amyloid (Aβ) peptide. Oxidative stress induced by reactive oxygen species (ROS) has been hypothesized to be a principal contributor in AD. The redox active metal ions iron and copper are found in AD plaques, suggesting that they might mediate ROS generation. Role of copper binding was studied as follows:

a) Copper binding status in Alzheimer's disease

DEPC assay was carried out on Aβ1-16 peptide in the absence and presence of various concentrations of copper. Our results (Figure 25) indicate that only one His residue is protected when Cu(II)/ Aβ1-16 ratio is equal to one which indicates that Cu(II) is bound to only 1 His residue. The results suggest that the most abundant species in solution contains only 1 His residues tightly bound to copper out of 3 His residues present in Aβ peptide. The species containing two or more His residues bound to copper are present in very less amount. Further, experiment was carried out on 100μM peptide and samples were analyzed by MALDI mass spectrometry. We found that the MALDI mass spectra (Figure 26) corresponds to four DEPC modifications at m/z 2027, 2099, 2171 and 2243 along with a peak for unmodified peptide at m/z 1955. While in the presence of Cu(II), the mass spectrum of Aβ1-16 after reaction with DEPC shows prominent peaks only for three modifications and the fourth peak at m/z 2243 is almost negligible. Also the intensities of peaks at m/z 2099 and m/z 2171 are significantly decreased while the intensity of the peak at m/z 1955 is increased. These results authenticate the involvement of only one His residue of Aβ1-16 in Cu(II) binding discovered by our spectrophotometric experiments. Further detailed studies to identify the exact number and position of histidine residues involved in copper binding are underway.

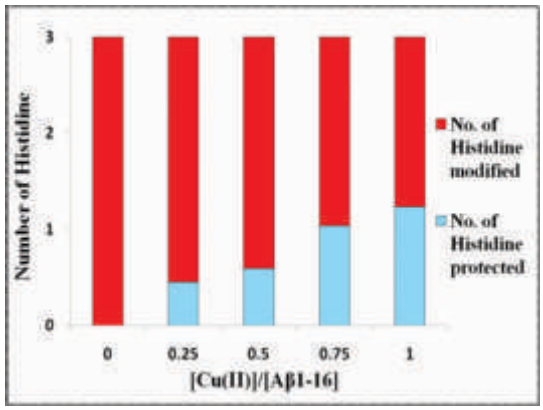


Figure 25 DEPC modification of Aβ peptide in the absence and presence of copper

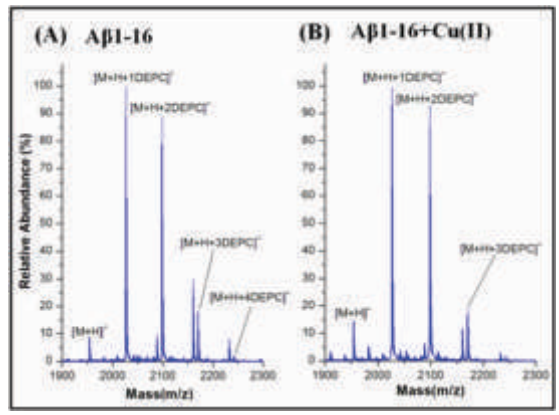


Figure 26 MALDI mass spectra of DEPC modified Aβ peptide in absence (a) and presence (b) of copper

b) Pulse radiolysis studies of Aβ1-16:

We also carried out pulse radiolysis studies on Aβ peptide and its copper complex. The transient spectra (Figure 27) showed that the reaction of OH radicals with Aβ peptide results in formation of TyrO· species while the presence of copper protects Tyr residue of Aβ peptide from the oxidation and causes the formation of dimer and trimer species.

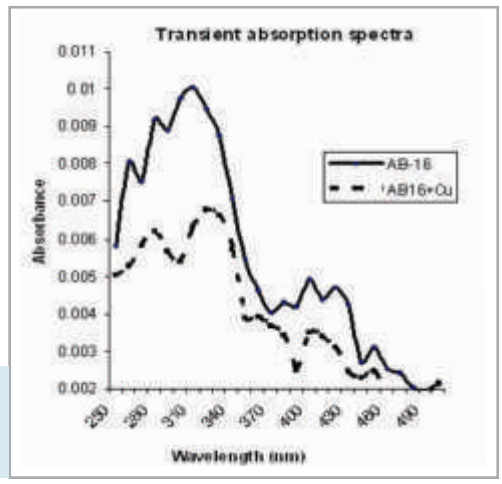


Figure 27 Transient absorptions spectra of Aβ peptide and Cu-Aβ. Absorbed doses: 7Gy per pulse

Developing Community Based Approach for Prevention and Management Of Anemia Through Nutritional Inputs and Awareness Among Young Rural Women In India

Under the all India coordinated program for prevention of anemia among young rural women 12 networking centers were coordinated from ARI. The analysis of socioeconomic data on 407 rural women (Table 14) showed that 67% women are married between the age of 16 to 20; 68% women have finished their primary education and most of these women (68%) are working in farms or as labourers. Only 18% cultivate green leafy vegetables in farms and 24% have kitchen garden. The analysis of obstetric history of women showed 93% women gave birth to full term babies and 61% fed milk to babies on first day. The prevalence of any anemia (Hb<12 mg/dl) in women was 78.6%, while 8.5% women were severely anemic (Table 15).

Table 14 Socioeconomic status of the women in the study

Parameter	n	% frequency
Menarcheal age (yr)		
<14	93	23.1
14 - 15	144	35.7
15 - 16	98	24.3
>=16	68	16.9
	403	
Age at marriage (yr)		
<16	57	14.2
16 - 18	148	36.9
18 - 20	123	30.7
>=20	73	18.2
	401	
Education		
< 4thstd	48	11.8
5th - 10thstd	279	68.6
>= 10thstd	90	20.0
	407	
Occupation		
House-wife	135	33.2
Farming or labour	255	62.7
Other	17	4.2
	407	
Cultivating GLVs in farm	72	17.2
Kitchen garden	99	24.3
Use of waste water for plants	95	96.0

Table 15 Prevalence of anemia in women

Anemia status	n	% frequency
Normal (Hb>=12mg/dl)	119	21.4
Mild (Hb :10-12mg/dl)	188	33.8
Moderate (Hb :8-10 mg/dl)	202	36.3
Severe (Hb<8 mg/dl)	47	8.5
Total	556	100.0

Resistant starch enriched prebiotic supplement for inflammatory bowel disorders

Use of prebiotics and resistant starch in particular having anti-inflammatory properties could be possible treatment for inflammatory bowel disease (IBD). The project is aimed at i) development of a process of increasing resistant starch in selected food materials, ii) assess their prebiotic and anti-inflammatory potential through in vitro and in vivo models. During the period under report 10 materials were selected for retrogradation based on autoclaving and cooling cycles. Three materials showed significant increase in RS. When the data of probiotic growth of retrograded samples was expressed as % of FOS, it was revealed that samples M1, P1 and C1 showed promising values. Prior isolation of starch had favourable impact on RS content while the slow cooling did not change the RS values. *Streptococcus lactis* and consortium A (Pro-Biotics Acidophilus) showed significantly higher growth than the other probiotic cultures.

Biodiversity

Bacteria

Isolation and characterization of obligate anaerobic bacteria from human gut

Studies on human gut microbiota are in the limelight now owing to their multivalent interaction with the host. It is estimated that 99% of gut microbiota is composed of anaerobic bacteria. Culture-based reports on obligate anaerobic bacteria present in the human gut are scanty and not reported so far from Indian subjects. We have isolated 65 obligate anaerobes from six healthy Indian individuals. Eleven more isolates were identified to species level in addition to 33 identified earlier. The databases of 16S rRNA gene sequence of these isolates are submitted to NCBI gene bank and are now accessible.

Two isolates namely BLPYG-7 and NMBHI-10 showed 16S rRNA sequence similarities of 97 and 96 % respectively with type strain of *Megasphaera elsdenii* (Figures 28, 29). Based on phylogenetic analysis, mole% G+C content, FAME analysis and carbohydrate utilization pattern these isolates could be said as the novel species of the genus *Megasphaera*.

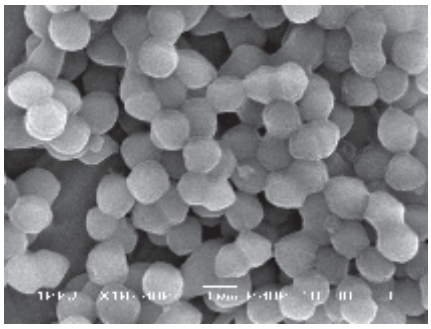


Figure 28 SEM micrograph of *Megasphaera*sp. BLPYG-07

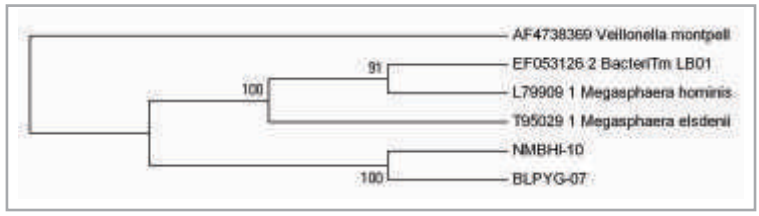


Figure 29 Phylogenetic tree:Consensus neighbour-joining tree of 16S rRNA gene sequences showing the phylogenetic positions of the novel coccoid strains BLPYG-07 and NMBHI-10 within the Megasphaera–Anaeroglobus group. Bootstrap values (expressed as percentages of 1000 replications) greater than 60 % are shown at the branch points. Species names are mentioned after GenBank accession numbers

Earlier, all isolates were characterised for their human health beneficial functional activities viz; bile tolerance, cholesterol reduction in presence and absence of bile, cell bound antibacterial activity against human pathogens. Presently, tolerance of the 65 isolates to gastric pH was studied. The growth of the isolates at pH 2 and 7 was monitored for 1, 2 and 3 hrs. Ten isolates showed increase in growth in terms of optical density at 600nm only in first hour whereas 17 and 38 isolates could grew for 2 and 3 hrs respectively.

Sensitivity/resistance of 65 isolates towards 11 antibiotics widely used against enteropathogenic infections was measured in terms of diameter (mm) of the zone of inhibition. A total 31 isolates were found to be resistant to ≥9 antibiotics, 13 were sensitive to ≥9 antibiotics and the rest showed resistance as well as tolerance to <9 antibiotics. Bile salt hydrolase (BSH) activity of the isolates was evaluated to confirm the cholesterol

precipitation with deconjugated bile. A total 60 isolates which displayed the precipitation zones were considered positive for BSH. Further BSH activity was mostly distributed in 4 genera viz *Bacteroides, Bifidobacterium, Parabacteroides* and *Clostridium*. During pathogenicity testing by blood haemolysis, 63 isolates proved non-pathogenic and two proved opportunistic pathogens. 35 isolates showing cell bound antibacterial activity against respective multi-drug resistant pathogens viz; *S. typhi, S. sonnei, E. coli,* and *K. pneumonia* were further studied. The antibacterial activity of these isolates was also observed in cell free supernatant. On adjustment of pH to neutral, 29 isolates lost their antibacterial activity. Out of remaining 6 isolates, only 4 lost their antibacterial activity after enzyme (proteinase K and trypsin) treatment, thereby indicating the proteinic nature of the antibacterial substance. The rest 2 isolates did not loose the acitivty due to enzyme treatment and their antibacterial substance might be of cyclic peptide nature (Table 16).

Overall, we have isolated strains belonging to 6 genera, viz., *Bacteroides, Parabacteroides, Clostridium, Megasphaera, Bifidobacterium* and *Dorea.* Few strains are selected (Table 17) which showed activities beneficial to human beings. Two isolates showing α hemolysis, *Clostridium subterminale* RSBHI-1 and *Clostridium subterminale* NMBHI-7, may be opportunistic pathogens.

Table 16 Isolates showing antibacterial activity

Description	Nature of antibacterial substanceNo. of isolates	No. of isolates
No of isolates showing cell bound antibacterial activity out of 65	Cell bound	35
No of isolates showing no antibacterial activity out of 65		30
No of isolates showing cell free antibacterial activity without pH adjustment out of 35	Cell free	35
No of isolates showing no cell free antibacterial activity after pH adjustment out of 35	Acidic	29
No of isolates showing antibacterial activity after pH adjustment to neutral out of 35		6
No of isolates showing no antibacterial activity after enzyme (proteinase K, trypsin) treatment out of 6	Single chain proteins	4 VLPYG-11, *Bacteroidesuniformis* NMBE-11, SaLPYG 17, and *Clostridium subterminale* VLPYG-2
No of isolates showing antibacterial activity after enzyme treatment out of 6	Cyclic peptide proteins	2 *Bifidobacterium adolescentis* SaLPYG-3 and *Parabacteroides distasonis* SLPYG-3

Table 17 Strains showing activities beneficial to human beings

Strains	Tolerance to		Cholesterol reduction (%)	Antibacterial activity against pathogensa	Resistant to number of antibioticsb
	Bile % (w/v)	pH 2.0 (Hrs)			
Bacteroides uniformis BLBHI-5	0.4	3	65	*S. typhi, S. sonnei*	11
Bacteroides uniformis NMBHI-11	0.4	3	47	*E. coli*	11
Bacteroides vulgates VLPYG-3	0.3	2	43	*S. typhi, E. coli, K. pneumonia, S. sonnei*	8
Clostridium subterminale BLPYG-8	0.4	2	47	No activity	11
Clostridium bifermentans NMBHI-8	0.3	2	40	*S. typhi, E. coli, K. pneumonia,* and *S. sonnei*	6
Parabacteroides distasonis SLPYG-3	0.4	3	63	*K. pneumonia, E. coli* and *S. sonnei*	8
Bifidobacterium adolescentis SaLPYG-3	0.4	3	68	*S. typhi, E. coli, K. pneumonia,* and *S. sonnei*	3

Studies on Forest Fungi

Studies on Plant Pathogenic/ Leaf Litter/Soil micro-Fungi

Tamini Ghats (Sacred groves), Mulshi, Mahabaleshwar, Panset and Pune and local areas were explored for the collection of mycological samples from diseased crops like, sorghum, tomato, onion and plant litter, wood, cattle dung, and rhizospheric soil. Detail study of the collected samples revealed several plant pathogenic, bioagents, coprophilous and saprophytic fungi of belonging to Hyphomycetes, Coelomycetes, Zygomycetes, Basidiomycetes and Oomycetes, which were isolated in pure form and documented. Some of the interesting fungi rediscovered from their hosts/substrates were *Absidia cylindrospora* (litter), *Acremonium* sp. (carvia dead stem), *Alternaria chlamydospora* (onion leaves), *Alternaria alternata* (Tomato leaves), *Botryosporium* sp. (plant litter), *Chalara fimbriata* (sugarcane), *Chaetomella* sp.(soil), *Cladosporium* sp. & *Phoma* sp. (tomato leaves), *Corynespora casiicola* & *Colletotrichum* sp. (*Ocimum sanctum)*, *Colletotrichum* sp. (*Guavava* fruit), *Corynespora cassiicola* (carvia dead stem)**,** *Curvularia brachispora* (*Sida acuta*), *Cylindrocladium* sp. (almond fruit), *Fumago* sp. (dead wood), *Fusarium solani* (watermelon plant), *Gliocephalotrichum* sp. (*Xantholis tomentosa* fruits), *Gongronella* sp. (Soil), *Metarrhizium anisopliae* (litter), *Monascus* sp. (leaf litter), *Paecilomyces lilacinus* (leaf litter), *Phytophthora palmivora* (Cocoa pod & Almond fruits), *Sirodesmium* sp. (Dead wood), *Sporisorium relianum* (Smut of *Sorghum vulgare*), *Stemphylium* sp. (Tomato leaves), *Stemphylium* sp. (Onion leaves), *Verticillium dahliae* (Watermelon), *Torula* sp. (Dalbergia bark), *Xylaria* sp. (Cattle dung), *Zygosporium* sp. (Dead

wood), *Colletotrichum gloeosporioides* (*Randia* sp.), *Alternaria alternata* (*Eucalyptus globulus*), *Pestalotiopsis* sp. (*Eucalyptus globulus*), *Beltrania rhombica* (*Mangfera indica*), *Pestalotiopsis* sp. & *Colletotrichum gloeosporioides*, *Periconia* sp. (*Erythrina stricta*), *Sporidesmium* sp. (dead twig). *Phytophthora palmivora* was authenticated by using ITS sequencing.

Considering poorly researched state of knowledge about Zygomycetes in general and saprophytic Entomophthorales, in particular from tropics, study was conducted in order to obtain fungi from soil and plant litter for their documentation and conservation in germplasm bank (NFCCI). During period under report a total eleven isolates of the genus *Conidiobolus* and one isolate of *Basidiobolus* were isolated from 30 soil and plant litter samples. These isolates were obtained following selective isolation technique. Since species of *Conidiobolus* and *Basidiobolus* are not studied in detail for their temperature requirements, all the isolates were studied at different temperature from 15-50^{0}C, (at increment of 5°C). Out of 11 isolates, three were thermophilic, and 3 were thermotolerant while others were mesophilic. The detail characterization of these isolates are in process.

To Isolate Endophytic Fungi from Medicinal Plants and their Metabolites

Endophytic fungi are considered as untapped resource and their specialized habituation make them an exciting field of study. Several classes of natural products reported including volatiles organic compounds (VOCs) having antibiotic potential produced by these endophytic fungi. With these backgrounds, work on biology of endophophytic fungi was initiated.

During period under report, a total 69 endophytic isolates were isolated from *Cinnamomum zeylanicum*. Identified isolates include *Colletotrichum gloeosporoides (8)*, *Colletotrichum* sp. (5), *Nigrospora* sp. (2), *Phyllosticta* sp. (2), *Myrothecium* sp. (1), *Phomopsis* sp. (1), *Phoma* sp. (7) and *Xylaria* sp. (3). In addition, 6 isolates found non-sporulating and slow growing. Out of these, two isolates producing soluble pigments in agar medium were subjected to induce sporulation for further taxonomic studies. The antimicrobial testing of all the isolates of *Cinnamomum zeylanicum* are in process.

National Facility for Culture Collection of Fungi

National facility for culture collection of fungi established by DST, Govt. of India provides services to various academic/research institutes in India. The core activity of facility is receipt, verification, accession, conservation of indigenous fungal germplasm, isolated from different habit and habitats, in National Fungal Culture Collection of India (repository) and supply of authentic strains. The facility also undertakes active research on various aspects of fungal systematics & bioprospecting.

Biodiversity and systematics of micro and macrofungi

The fungal diversity of tropical region is under explored, and is conservatively calculated as 1.5 M. However, 90% of the total fungal estimated diversity is yet to explored. Biological prospecting of fungi are considered to play an important role in generating bio-economy by exploring their genetic and biochemical diversity from natural resources. With these backgrounds, forests of the Western Ghats were explored for the collection of fungal diversity, *ex situ* conservation and their documentation. The collection trips to Mulshi, Mahabaleshwar, and Kerala (Peechi, Karadka) were made.

Microfungi

During period under report iinteresting microfungi isolated from their hosts and studied in detail were *Colletotrichum gloeosporioides (Randia dumatorum), Pestalotiopsis maculans (Randia dumatorum), Alternaria* sp. *(Fern), Cylindrocladium quinqueseptatum (Olea dioica), Phyllosticta* sp. *(Terminalia chebula), Pyricularia* sp. *(Smilax zeylanica)*, *Amphispaeria stellata* (*Bambusa bamboos*), *Pleosporium wehmeri* (*Delonix regia*), *Thelonectria* sp. (*Dalbergia horrida*), *Ophionectria* sp. (*Dalbergia horrida*), *Cordana vasiformis*, *Nectria* sp., *Edmundmasonia pulchra*, *Helicomyces* sp., (on litter), *Sporidesmium karadkensis* (Bamboo), *Melanographium citri* (Coconut leaves),

Tetraploa sp.(litter Bamboo), *Sporidesmium macrurum* (*Borassus flabellifer*), *Circinotrichum* sp. and *Microsphaeropsis* sp. (Palm), etc. However, in detail studies some of fungal taxa turned out to be novel species which were described in detail were as follows:

***Pseudocercospora* (Hyphomycete)**: An unusual *Pseudocercospora* species causing foliar infection on *Terminalia chebula* was collected and *in vitro* culture was successfully raised. The details morphological studies were undertaken which revealed this taxon to be unrecorded. Detail taxonomic treatments and comparative analysis of morphotaxonomic features with closely related species indicated that this is new to science (Figure 30). The novelty this taxon was further confirmed by molecular studies.

***Manoharachariella* (Hyphomycete)**: An interesting collection from Mulshi forest of Northern Western Ghats was collected. Detailed taxonomic studies revealed that the present collection belongs to the genus *Manoharachariella* established in 2009. Comarasion of morphotaxonomic features with type species *M. lignicola* indicated it to be an un-described species, which was described and established as new species, *Manoharachariella indica*. This strain was successfully cultured by single spore isolation technique (Figure 31)

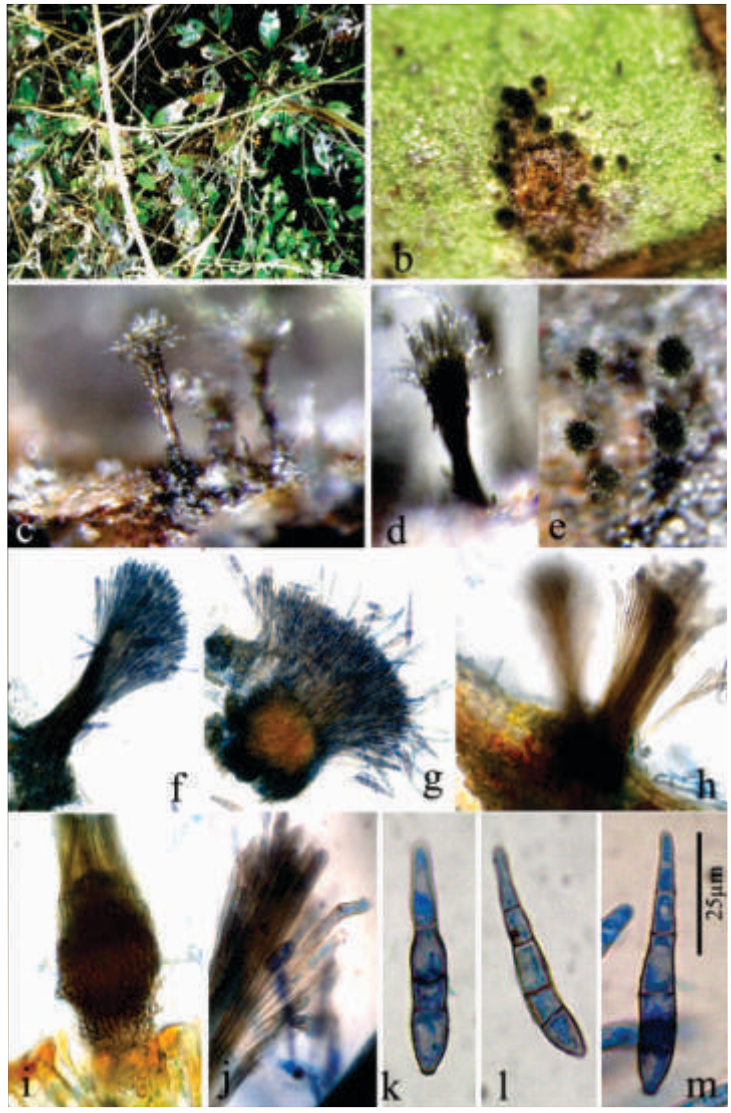


Figure 30 *Pseudocercospora kamalii* Rajesh Kumar et. al.

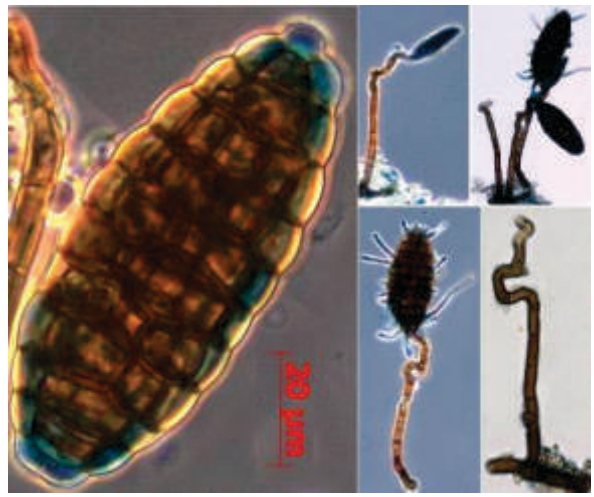


Figure 31 *Manoharachariella indica* RajeshKumar & Singh

Macrofungi

A total of 64 macrofungi were collected from Pune, Mahabaleshwar and Mulshi forest areas of Western Ghats of Maharashtra. All the samples were studied and assigned to 56 species in 47 genera belonging to 27 families. A total of 10 species from Mahabaleshwar and 11 species from Mulshi forest areas were collected and studied. Thirty-five species were collected from in and around Pune. The agaric diversity was very high

followed by polypore diversity throughout the areas surveyed. Considerable habitat diversity was found among the mushrooms and most of the agarics were collected from soil and polypores from wood.

Among the collected samples, an interesting sample was collected and morphotaxonomic characters were studied and which belong to genus *Volvariella*. The diagnostic morphotaxonomic characters of this species are the large, white fruit-bodies, the relatively small basidiospores and cylindric-clavate pleuro- and cheilocystidia. Based on its distinct features, this species was described established as new species as *Volvariella sathei* (Figure 32).

Figure 32 *Volvariellasathei*Senthil et al.A. Surface view B. Gill view

Some other interesting species collected and studied were *Calvatia exipuliformis* (Figure 33b), *Ileodictyon cibarium* (Figure 33a), *Macrolepiota procera*, *Marasmius* sp. (Figure 33e), *Leucoagaricus rhodocephalus*, *Mycena* sp. (Figure 33d), *Lentinus sajor-caju*, *Oudemansiella* sp. (Figure 33c), *Lepista sordida*, *Polyporus* sp., *Daedalea quercina*, *Tricholomopsis* sp., *Hypoxylon haematochorum, Macrocybe gigantea* (Figure 33f) and *Hygrocybe alwisii*.

Molecular Systematics and Phylogeny of Fungi

During period under report 51 strains of fungi which were received for molecular identification (from outside institute on charged basis) were subjected to molecular characterization. Out of 51 samples received, 20 samples were for package category and 31 were for ITS category. Out of total samples received 58% samples were with "unidentified fungus" tag (unidentified-30; partially identified-10; wrongly identified-8 and correctly identified-3). The samples analyzed included plant pathogens, veterinary isolates, mushrooms, etc. Of the total samples received after molecular identification 54% of them belonged to Ascomycetes [ascomycetes 28; basidiomycetes 12; zygomycetes 3, and others 14].

Figure 33 a. *Ileodictyoncibarium,* ***b.*** *Calvatiaexipuliformis*, **c.** *Oudemansiella* sp., **d.** *Mycena* sp., **e.** *Marasmius* sp., **f.** *Macrocybegigantean*

Phylogeny of a new species of *Pseudocercospora* : In addition to the morphotaxonomic treatment, molecular studies were done using LSU and ITS sequencing. The phylogenetic analysis revealed its identity as genus *Pseudocercospora* and ITS sequencing confirmed it as a species new to science based on the comparison of data in NCBI and CBS databases. This taxon was established as *Pseudocercospora kamalii* (Figure 34 & 35). The rDNA sequence generated was deposited in the NCBI's GenBank DNA database (ITS: JF 824126, LSU: JF 824127).

Phylogeny of a new white species of *Volvariella* : A probable new species of *Volvariella* was recognized by morphological features. To ascertain its phylogenetic position within the genus *Volvariella* it was subjected to molecular phylogenetic analysis using sequence from the ITS region. Phylogenetically, it is close to *V. nivea* which also forms white basidiocarp, but possess sufficient sequence divergence to be considered as separate species (Figure 36). The rDNA sequence generated was deposited in the NCBI's GenBank DNA database (JN792550).

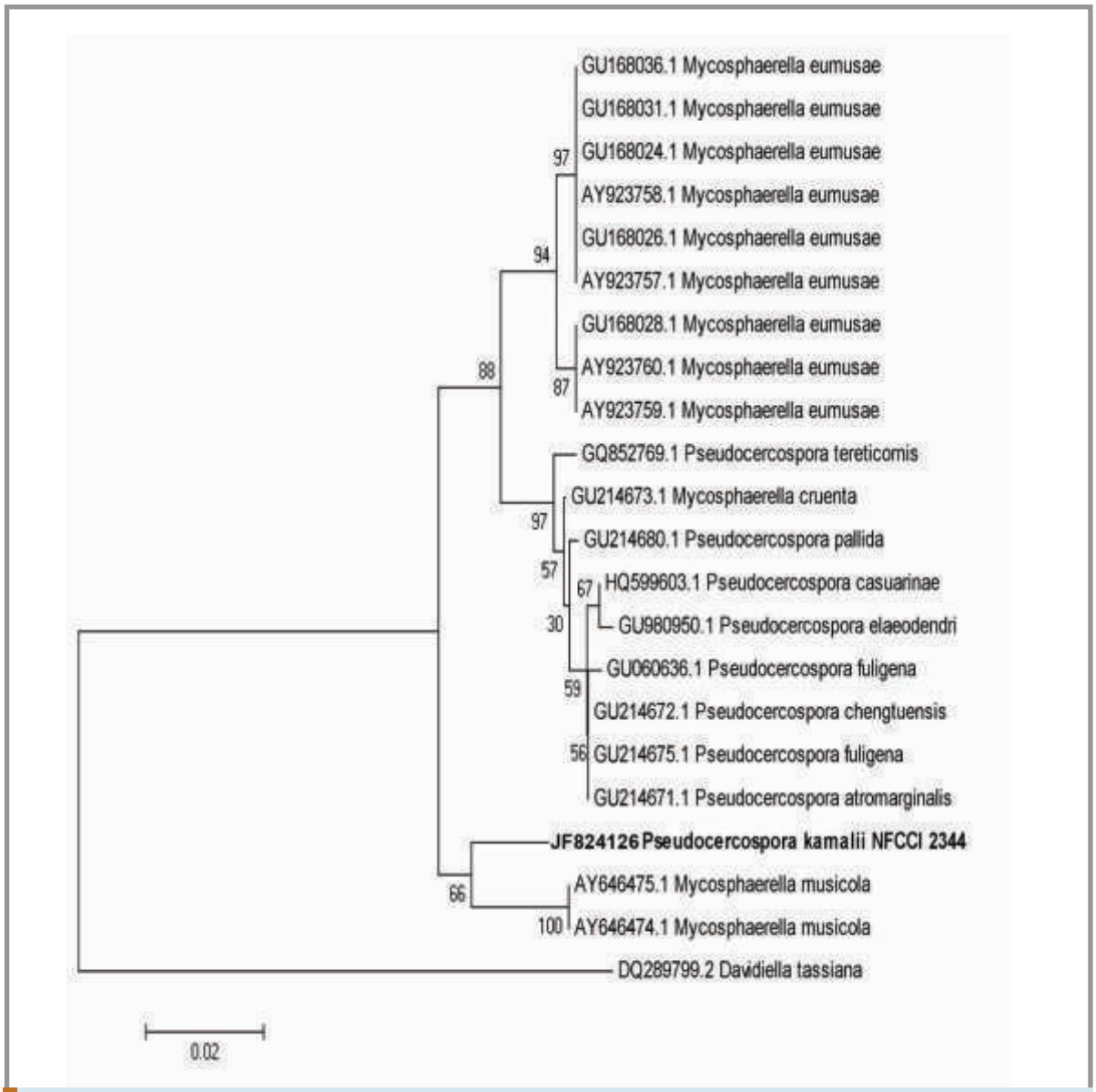


Figure 34 Phylogenetic tree based on aligned ITS sequences of *Pseudocercospora* and its teleomorph

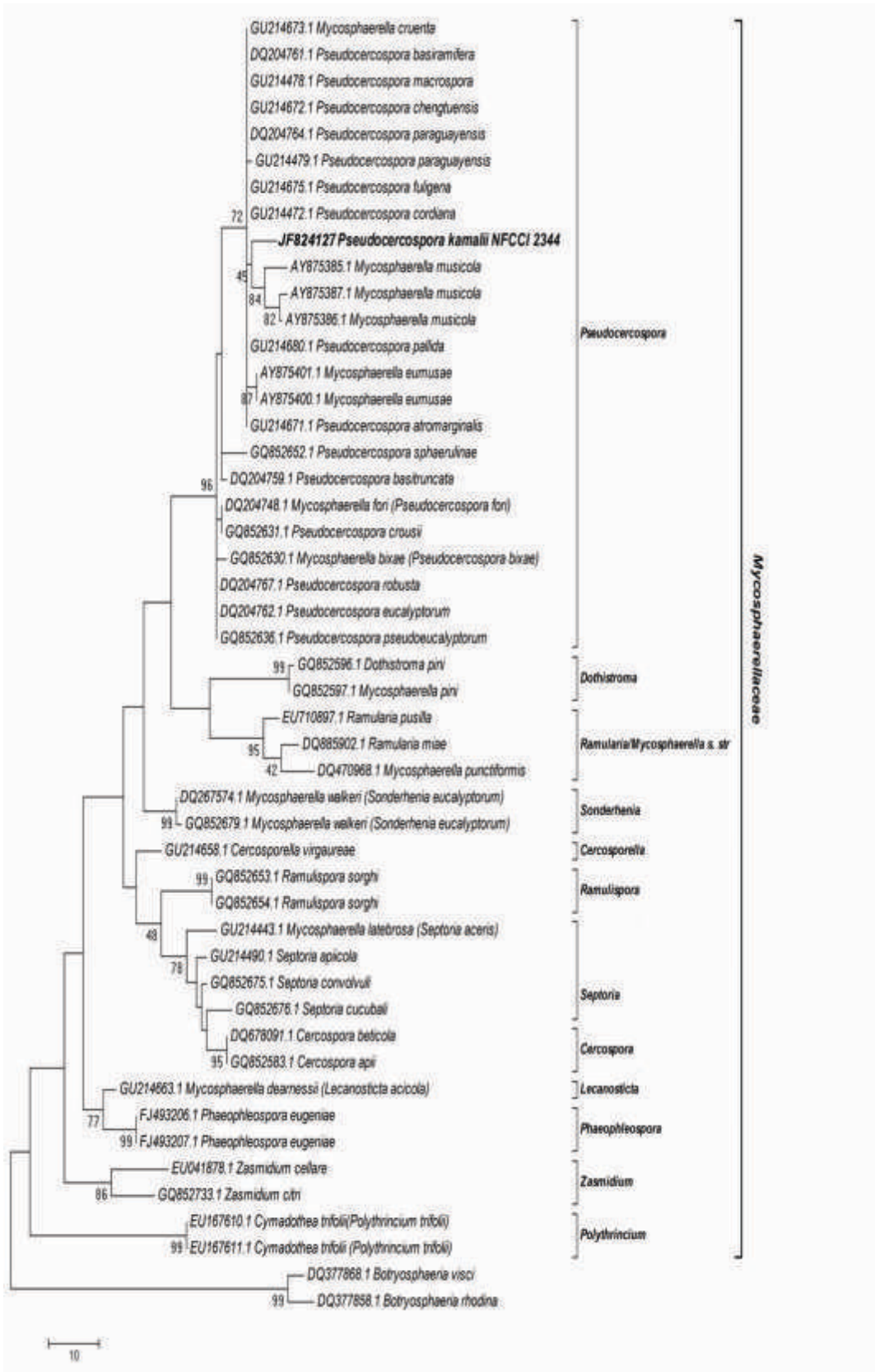


Figure 35 Phylogenetic tree based on aligned LSU sequences of *Pseudocercospora* and its teleomorph

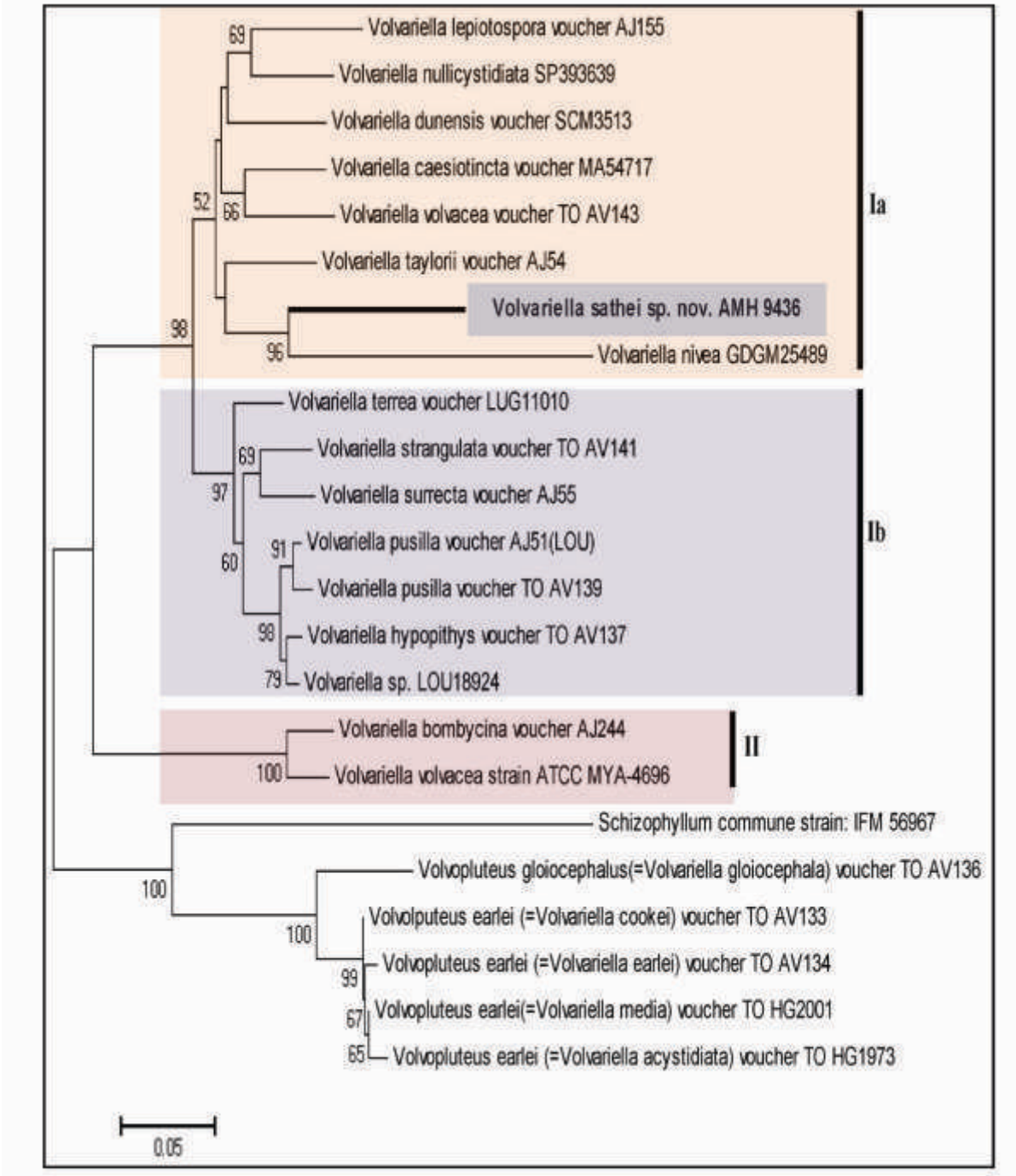


Figure 36 Neighbour joining phylogenetic tree of *Volvariella* species constructed using ITS sequences of new species and related species of the genus showing phylogenetic positioning of *V. sathei* .

Biodiversity of Lichens in Western Ghats of India

Morphological, anatomical and chemical studies of the lichen family Graphidaceae from South India have resulted into the identification of 67 segregate into 6 genera. The occurrence of six new species of the lichen genus *Carabcacnthographis* has been recorded.

Morphological, anatomical and chemical studies of *ca.* 100 specimens of foliose lichen family Lobariaceae have resulted into the identification of 3 genera *Lobaria, Sticta,* and *Pseudocyphellaria.*

An account of the lichen genus *Usnea* from Western Ghats of India has been prepared. Four species of *Usnea, Usnea austroindica, U. nilgirica, U. strigosa* and *U. tumida* are rediscovery.

Taxonomic studies of over 150 foliose and fruticose lichen specimens were completed. The detailed taxonomic descriptions of *c.* 15 species together with the notes on habitat, geographical distribution, and a short discussion on the phylogenetic relationship of the species have been completed.

Bioinformatics and Database Management

Computational analysis of polyketide synthase (PKS) enzyme of fungus producing natural colorants: Biopigments are considered as promising alternatives to synthetic colorants. Fungal pigments are produced as secondary metabolites and are broadly classified chemically as carotenoids and polyketides. Many fungi have been reported to produce polyketide pigments, but only a few of them have been explored as possible food colorants. *Monascus* spp produces red-yellow polyketide pigments, which is the most important because of its traditional use as a natural colorant in the production of certain fermented foods in East Asia.

Since biochemical reactions and enzymes involved in pigments formation in fungi are unknown, and not yet fully worked out, which leads sometimes to inconsistencies in large scale fermentation and production of the polyketide pigments. Using bioinformatics tools it was possible to assume that at least one, or possibly two, polyketide synthase (PKS) may be involved in the biosynthesis of polyketide pigment in selected fungus. The biosynthesis of polyketide is involved in multiple enzyme systems and pathways, including polyketide synthesases (PKS), biosynthesis of precursors, precursor regulated pathways, and modification of intermediate reaction. The 3-D structure and functional annotation of PKS in selected fungus was predicted with the help of bioinformatics web server tools. The predicted 3-D structure associated with 3 domains, Acyltransferase (AT), Ketosynthase (KS) and Likers of AT & KS were involved in 3-D structure. The functional annotation was predicated that PKS plays major role in three important processes, viz., biological process, metabolic process and biosynthetic process of *M. purpureus*.

In addition, work on database management and web application related to National Fungal Culture Collection of India was also continued and databases/inventories were updated.

Plants

Collection, Conservation and Multiplication of Germplasm of Wild Resources

Seed and Seedling Studies On High Valued Medicinal Plants

Forty seed accessions were studied for their taxonomic position, common names, season of flowering and fruiting, morphological descriptions (shape, size, colour, surface type, number of seeds per fruit, seed weight), identification keys along with photo-documentation. Seed germination studies were conducted for 30 more species. The observations were made with respect to percentage germination, germination period and type of germination. Efforts were made to record seedling morphology till 6 leaf stage. These studies will help in preparation of seed and seedling identification manual for easy identification.

Plant Community Studies on Selected Grasslands of Western Maharashtra

Literature on grasses, grasslands and their ecology was screened to develop SOP for quantitative ecological approach. Herbarium specimens were studied in Botanical Survey of India, Western Regional Station, Pune (BSI) and Agharkar Herbarium at Maharashtra Association for Cultivation of Sciences (AHMA) for location specific records on grasslands.

Field tours were arranged to Mahatma Phule Agricultural University Campus in Ahmednagar district, Laling grassland and Lamkani Grassland in Dhule district and Talegaon in Pune district. About 16 quadrats were laid in these regions for quantitative studies of grasslands. During this study focus was laid on studies of various communities and composition of grasslands.

Indian Grassland & Fodder Research Institute, Dharwad Regional Research Station was visited for understanding their research programs and library consultation.

Digitizing Herbarium – AHMA

Under Herbarium studies selected species were studied critically. Some of them were found to be new distributional records.

Luffa hermaphrodita N. B. Singh and Bhandari, earlier recorded from Bihar, Rajasthan, and West Bengal was recorded for the time from Maharashtra and Gujarat (Figure 37).

Surveys and documentation for present distribution of family Orchidaceae of Maharashtra revealed a new record to Maharashtra state in the form of *Smithsonia straminea* C.J. Saldanha. This species is endemic to Western Ghats and was earlier reported only from Karnataka and Kerala (Figure 38).

A specimen belonging to *Celosia argentia* L., showing teratological features was studied critically and the variations were documented.

Digitized Inventory of Medicinal Plant Resources of Maharashtra

A multi-centered project with 14 collaborators all over Maharashtra aims at developing database and digitization of medicinal plant resources with reference to distribution, diversity and availability of resources of commercial value and species of local use value.

Data compilation and data entry in data base: Morphological description of 360 medicinal plants was completed. Data entries of 402 medicinal plant resources with respect to habit, regional names, phenology, recent citation, synonyms and part used were completed. Medicinal utility of 360 resources occurring in Maharashtra was compiled from literature. Documentation of medico-botanical surveys of thirty four districts of Maharashtra was completed. The requirement of medicinal plant resources was compiled from 27 Ayurvedic pharmacies. Compilation of references is being continued taking total number of references to 1147.

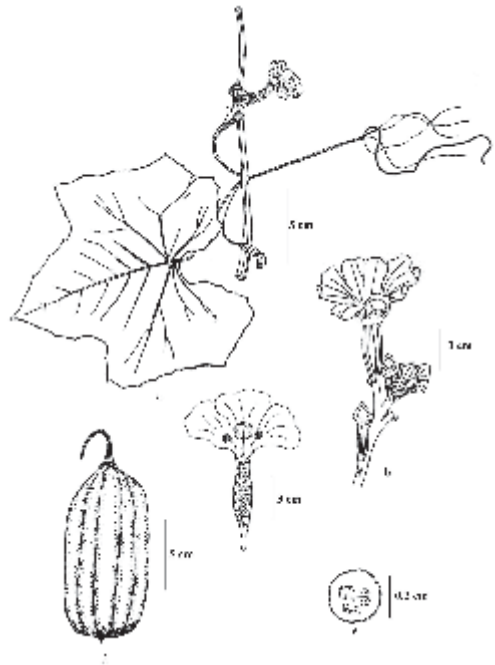
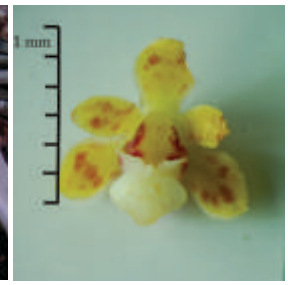


Figure 37 *Luffa hermaphrodita* N. B. Singh and Bhandari
a. twig; b. inflorescence; c. LS of flower; d. fruit; e. TS of ovary

Habitat of the orchid

Habit

Sepals and petals without red spot: variation



Flower close-up

Pollinia

Capsule

Figure 38 *Smithsoniastraminea* C. J. Saldanha

Recovery of Rare Endangered Threatened (RET) Species of *Ceropegia* from Western Ghats

Under this project efforts are being made to micropropagate RET *Ceropegia* species viz. *Ceropegia rollae, Ceropegia maccannii, Ceropegia mahabalei* and *Ceropegia odorata* of Western Ghats. The standardization of growth medium by permutation and combinations is being done.

During experimentation *Ceropegia mahabalei* Hemadri et Ansari unique observation tricotyledony was documented (Figure 39).

Studies on Diet Preferences of Plant Species Favoured by Indian Giant Squirrel (*Ratufa indica*) and their Regeneration in Rai and Chaura areas of Bhimashankar

Literature survey on various food species of giant squirrel was done. A small checklist of food species consumed by giant squirrel was prepared based on earlier literature and in consultation with forest department and local people. Fifteen transect were laid to document various growth stages of these food species. Observations were made for food species, nest preferences and phenology of the food species.

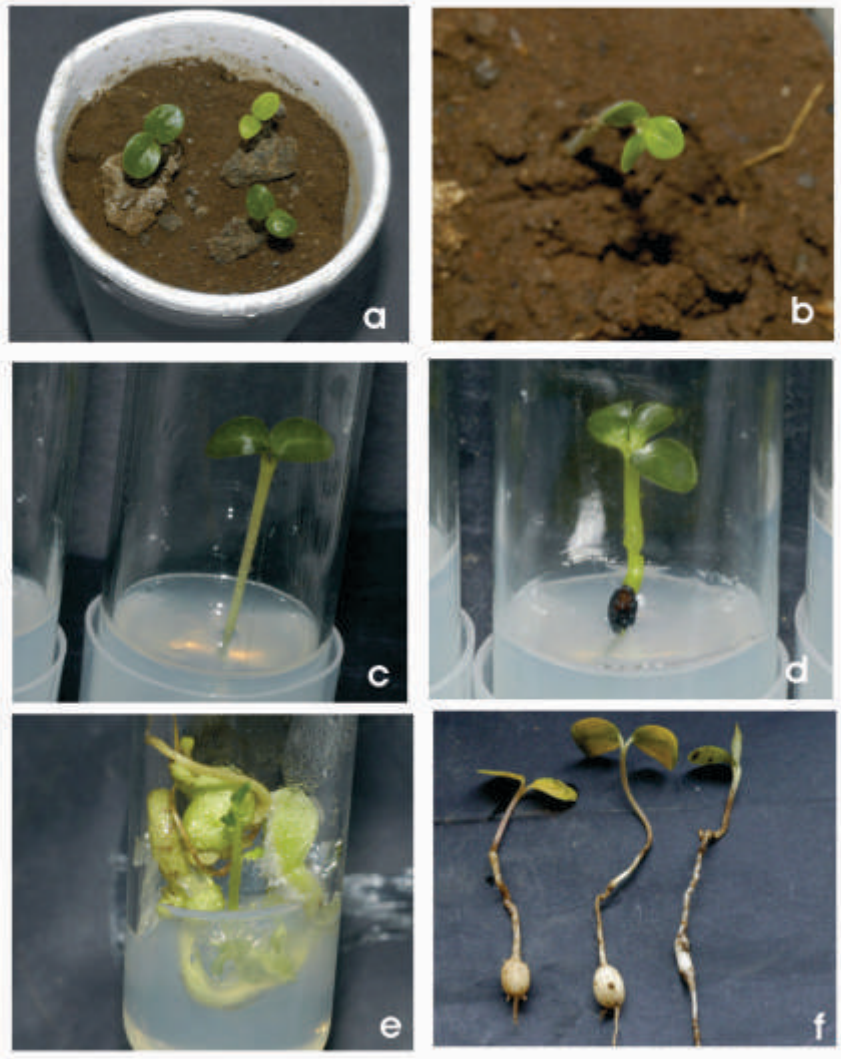


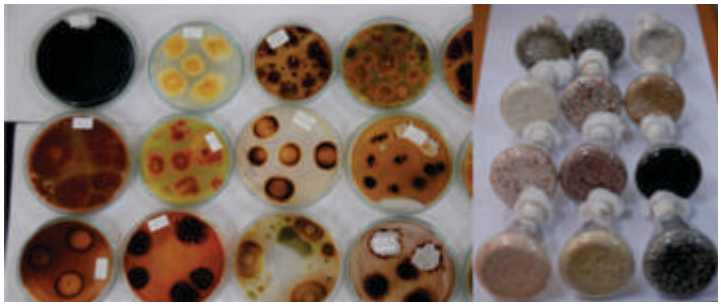
Figure 39
Ceropegiamahabalei
Hemadriet Ansari

Seed germinated in soil: dicotyledonous
(a) and tricotylednous
(b) Seed germinated in basal MS medium dicotyledonous
(c) and tricotyledonous
(d) e: development of shoot on root in basal Ms medium
f: Tuber formation in seedlings when germinated in soil

Natural Product Chemistry

Melanins are dark brown heteropolymeric, high molecular pigments formed by the oxidative polymerization of phenolic and indole compounds and are generally produced by the oxidation of L-tyrosine. Sunscreens containing water soluble melanin protects against harmful UV radiation, which is reported as major causative factor of melanoma and other cancers of the skin. UV-absorbing properties of melanin have tremendous biotechnological potential in skin care formulations, optics and plastics. Fungal melanin is reported to protect organism against ionizing radiations.

With these backgrounds, screening of different fungi was undertaken by plate assays method. The fungal strains were selected based on extracellular pigment production/diffusion of pigment (s) in Petri-plates and in Solid state fermentation containing different selection media (Figure 40 a,b). The melanin was extracted and purified from Submerged (SmF) and Solid-state fermentation (SSF) from the selected isolates based on melanin production. It was observed that tyrosin is a precursor for melanin production (Figure 41). The extracted and purified pigment sample was scanned by UV-Vis spectrophotometer between wavelength 200 - 700 nm. The confirmation of purified melanin was done by comparing with standard and biochemical reactions. Utilization of agro-waste for melanin production was also tested. Melanin were oxidized and completely bleached over 24 hours in the presence of hydrogen per oxide (Figure 42). I*n-Vitro* hydrogen per oxide activity on Melanin producing fungi was also tested.



a. b.

Figure 40
a. Screening of fungi for pigment production
b. Cultivation of selected fungi on solid substrate for pigment production

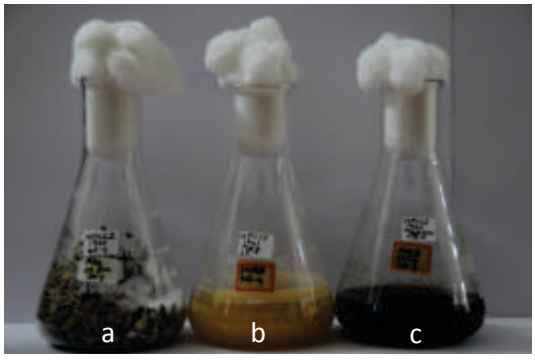


Figure 41 Fermentation of melanin; a: SSF; b: SmF without tyrosine-No melanin production; c: SmF with tyrosine showing melanin production.

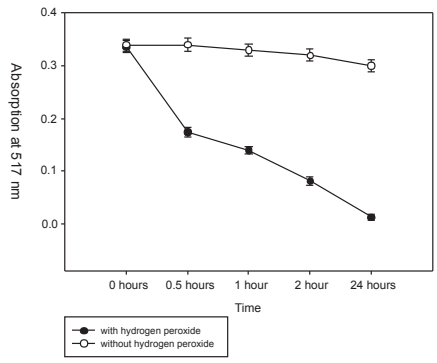


Figure 42 Effect of hydrogen peroxide on absorption of melanin

Lichens

Antibacterial Activity of Secondary metabolites of Lichen

In present study, bactericidal potential of some lichen secondary compounds has been presented. Three lichen species namely *Cladonia ochrochlora*, *Parmotrema nilgherrensis* and *Parmotrema sancti-angelii* were successively fractionated in various organic solvents n-hexane, ethyl acetate, acetone and methanol. The ethyl acetate fraction (10 µg/ml) of these lichen species showed promised bactericidal activity and the order of the activity of lichen species were found as *P. nilgherrensis* > *P. sancti-angelii* > *C. ochrochlora* (Table 18). Seven lichen secondary compounds alectoronic acid, atranorin, α-collatolic acid, fumarprotocetraric acid, hypoprotocetraric acid, lecanoric acid and protocetraric acid isolated from ethyl acetate fraction of above lichen species demonstrated moderate to strong bactericidal activity with low MIC value; alectoronic acid showed MIC 21.9 µg to 162.1 µg/ml, atranorin (5 µg - 70.7 µg/ml), α-collatolic acid (8.6 µg - 245 µg/ml), fumarprotocetraric acid (24 µg - 227.3 µg/ml), hypoprotocetraric acid (12.2 µg - 278.5 µg/ml), lecanoric acid (24.6 µg - 591.7 µg/ml), protocetraric acid (18.7 µg - 740.7 µg/ml (Table 19). These secondary compounds were found most effective to kill microorganisms within a period of 0 hrs to 6 hrs incubation as evident from the kinetic time kill assay study. As far as the stability of the lichen compounds for the observed activity, it was found that these compounds were stable at 4°C without loosing their bactericidal potential (Table 20). These results indicate that the above lichen compounds can be used as possible bactericidal agents in food and pharmaceutical industry.

Plants

Standardization of medicinal plants

Repository of crude drugs

The repository of crude drugs was enriched by 70 accessions taking the total repository number to 750. Ajowan fruits are used medicinally in modern as well as traditional system of medicine as antioxidant, carminative and anthelmintic. Three species viz. *Trachyspermum ammi, Trachyspermum roxburghianum* and *Apium graveolens* known and sold in markets as Ajowan were studied for macroscopic, microscopic and organoleptic characters and TLC profiles and observations are being compiled in suitable format for publication.

Similar studies have been conducted for crude drug Nagkesar, a major constituent of formulations, '*Samsarkara churna*', '*Pushyanugachurna churna*'. Studies revealed that three different species *Calophyllum inophyllum* (flower buds), *Mesua ferrea* (stamens), M*ammea longifolia* (flower buds) are sold under the name of Nagkesar. Pharmacognostic standardization of these materials has been completed and antioxidant studies on hydro- distillated oil were done. The observations and results are being compiled for publication.

Hepatoprotective effect of stamen of *Mesua ferrea* L. against oxidative stress induced by CCl_4 in liver slice culture model was done. *In* vitro assay was carried out to evaluate an antioxidant activity using different extracts. The results exhibit significant correlation in total phenol content and free radical scavenging activities of all extracts. The highest antioxidant activity of hexane extract and EtOH extract may be due to presence of phenolic compounds. Percentage inhibition of free radical by *M. ferrea* stamen extracts at various concentrations is presented in Figure 43.

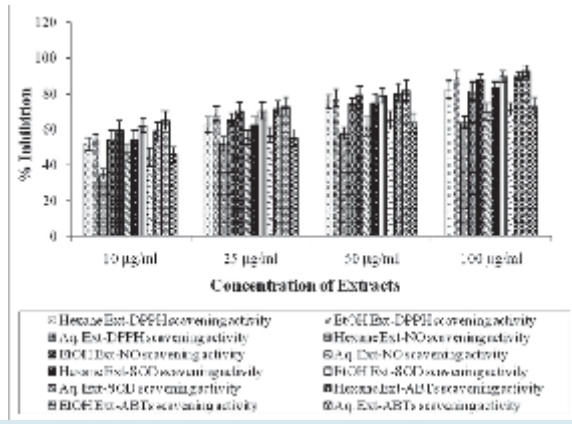


Figure 43 Percentage inhibition of free radical by *M. ferrea* stamen extracts at various concentrations

Table 18 Antibacterial activity (zone of inhibition, mm) of various solvent fractions of lichen species and standard antibiotics

Lichen species / Solvent extracts	Bacterial Strains									Yeast strains	
	B. cereus	*B. subtilis*	*E. coli*	*K. pneumoniae*	*M. luteus*	*P. vulgaris*	*S. aureus*	*S. faecalis*	*S. lutea*	*C. albicans*	*C.diffluens*
Cladonia ochrochlora											
n-Hexane	--	--	--	--	--	--	7	7	--	--	–
Ethyl acetate	8	10	8	12	10	10	10	8	9	8	9
Acetone--	--	--	--	--	25	--	--	--	--	–	
Methanol	--	7	7	--	7	20	--	--	--	--	–
Parmotrema nilgherrensis											
n-Hexane	--	--	--	8	--	10	--	7	--	--	–
Ethyl acetate	11	10	8	11	10	20	8	12	10	12	13
Acetone7	8	10	--	10	13	10	10	--	7	8	
Methanol	11	--	7	--	10	--	10	7	--	7	7
Parmoterema sancti-angelii											
n-Hexane	--	7	11	--	--	10	7	--	--	7	–
Ethyl acetate	8	8	--	9	10	13	10	10	10	8	9
Acetone--	--	--	--	--	7	--	--	--	--	–	
Methanol	--	--	--	7	--	--	--	--	--	–	7
Standard antibiotics											
Erythromycin	10	25	25	29	22	15	23	17	Complete Inhibition	13	16
Gentamicin	7	15	15	10	25	22	20	17		15	15
Methicillin	--	12	10	20	15	--	20				
Streptomycin	15	20	10	22	15	--	15				
Tetracycline	15	25	25	25	23	22	23				
Vancomycin	10	20	14	22	14	15	18				

The value of each constituents consisted of ± S.E. of three parallel readings. **(--):** No inhibition

Table 19 Minimal inhibitory concentration (MIC) values of isolated lichen compounds for the antibacterial activity

Microorganism	Alectoronic acid	Atranorin	α- Collatolic acid	Fumar-protocetraric acid	Hypo -protocetraric acid	Lecanoric acid	Protocetraric acid	Erythromycin	Gentamycin
Bacterial strains									
B. cereus	162.1	-	245.0	59.6	255.4	26.9	85.5	4.8	4.3
B. subtilis	98.1	70.7	46.2	-	53.1	24.6	740.7	4.2	5.0
E. coli	40.0	8.3	28.1	24.7	76.7	68.0	-	4.7	4.6
K. pneumoniae	54.9	13.0	34.4	142.2	90.7	-	-	4.3	5.1
M. luteus	75.0	17.8	-	-	178.0	-	-	4.8	4.9
P. vulgaris	59.7	5.0	21.6	24.0	12.2	-	23.4	5.1	4.6
S. aureus	62.2	20.5	83.9	-	118.6	-	60.7	4.8	4.4
S. faecalis	21.9	33.0	44.2	39.00	278.5	296.3	-	4.0	5.0
S. lutea	-	21.5	32.1	103.6	93.8	591.7	196.0	4.6	4.5
Yeast strains									
C. albicans	22.7	17.0	8.6	227.3	-	-	18.7	5.0	4.9
C. diffluens	-	15.7	51.5	24.4	110.3	50.1	53.1	5.8	5.5

***MIC:** Minimal inhibitory concentration values given as µg/ml for lichen compounds and standard antibiotics; **(-):** Not sensitive

Generation of Marker Phyto-constituents and Development of Repository for Quality Standards of Indian Medicinal Plants

Nine monographs were prepared and submitted to Indian Council of Medical Research (ICMR) for publication. The herbarium specimens, spectral data and isolated phytoconstitutent of sixty markers were submitted to ICMR. One set of herbarium specimens was deposited in AHMA repository.

Quality standards of Indian medicinal plants

In order to accept herbal medicinal products at global level, Indian Council of Medical Research (ICMR) is publishing monographs of Indian Medicinal Plants following World Health Organization guidelines. Under this sponsored project monographs on quality standards of Indian medicinal plants are being developed by combined efforts of Botany and Chemistry Groups. Following monographs were completed and submitted to ICMR for publication (Table 21).

Evaluation of Antioxidant Potential From Plant Resources: Fruit and Vegetable Juices

Under this project antioxidant potential of local and branded ready-to-drink juices are being studied.

Various branded, local made as well as authentic juice of *karela* (*Momordica charantia* L.) Family Cucurbitaceae, prepared in ARI laboratory were documented for total microbial count, local made *karela* juice showed heavy microbial load as compared to branded and laboratory made juices. The physicochemical properties of all the juices were recorded with respect to total dissolvable solutes, density, pH, moisture, total carbohydrates and protein. Similarly antioxidant activity of all the samples was also recorded. The results indicated that branded juice showed highest antioxidant potential followed by ARI juice sample and local market juice showed least antioxidant potential in DPPH scavenging assay. All the

Table 20 Antibacterial activity shown by the lichen compounds incubated under various temperature and finally after 30 days incubation at 20 °C

Lichen Compounds	Average activity at 4 °C/1hrs/0 day	Average activity at 40°C/1hrs	Activity decrease (%)	Average activity after 30 day at 20°C	Activity decrease (%)
Alectoronic acid	51 - 99%	34 - 83%	17 - 25%	12 - 50%	15 - 87%
Atranorin	37 - 84%	13 - 65%	14 - 64%	23 - 59%	14 - 47%
α-Collatolic acid	39 - 93%	28 - 62%	20 - 69%	10 - 58%	20 - 84%
Fumarprotocetraric acid	40 - 99%	30 - 87%	16 - 39%	14 - 83%	17 - 86%
Hypoprotocetraric acid	35 - 98%	28 - 88%	11 - 27%	10 - 81%	18 - 84%
Lecanoric acid	37 - 95%	14 - 84%	11 - 47%	18 - 40%	17 - 92%
Protocetraric acid	29 - 97%	17 - 86%	11 - 54%	3 - 53%	86 - 94%

*** Average activity:** Bactericidal activity of lichen compounds for all tested microorganism

Table 21 Monographs completed

No.	Plant Name	Plant Part
1	*Argemone mexicana* Linn.	Plant, Oil, Latex, Root
2	*Calophyllum inophyllum* Linn.	Seed oil
3	*Glycine max* Merr.	Seed
4	*Manihot esculenta* Lam.	Rhizome
5	*Sphaeranthus indicus* Linn.	Fruit
6	*Tectona grandis* Linn.	Heart wood
7	*Litsea glutinosa* (Lour.) C.B.Rob.	Stem Bark
8	*Carissa carandas* Linn.	Root

karela juices were studied in detail for their antioxidant activity by different antioxidant assay and also for photo-chemiluminiscence assay. The data is documented in Figure 44.

Development of HPTLC Profile Library of PRS (Phytochemical Reference Standard)

This project aims to develop phytochemical reference standards (PRS) library by HPTLC profiling for selected Indian medicinal plants. Worksheet for validation and documentation of results was formulated as per ICH guidelines. Standardization of mobile phase for selected PRS is a continuous process. During this report time 5 PRS were standardized. The use of Accelerated Solvent Extraction (ASE) as an alternative to conventional techniques was explored. Samples were extracted using ASE validated HPTLC method that has been established for the determination of piperine and piperlongumine in methanolic root extract of Pimpali (PL) and its commercial formulation 'Mahasudarshan churna®' using ICH guidelines. HPTLC chromatograms of methanolic extracts of genuine root and its formulation along with standards piperine and piperlongumine at 300 nm is represented in Figure 45. Extraction of plant using ASE and rapid HPTLC method provides a new and powerful approach.

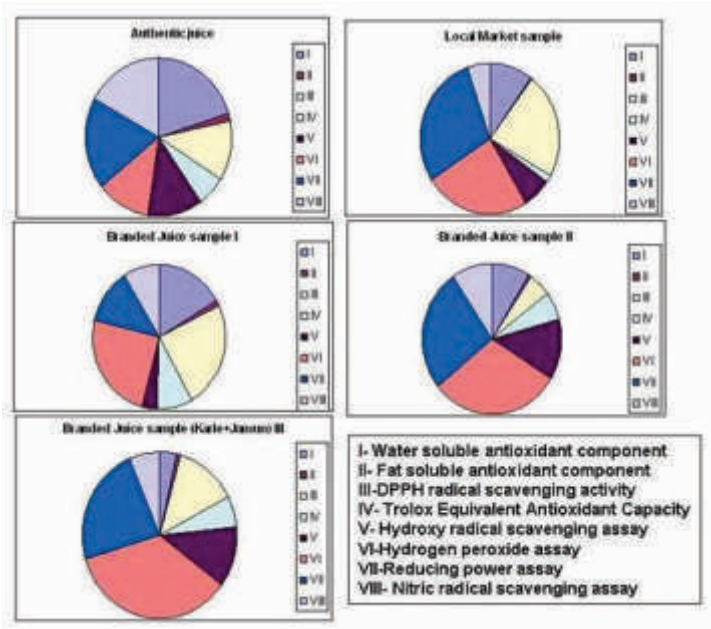


Figure 44 Antioxidant activity of different Karela juices

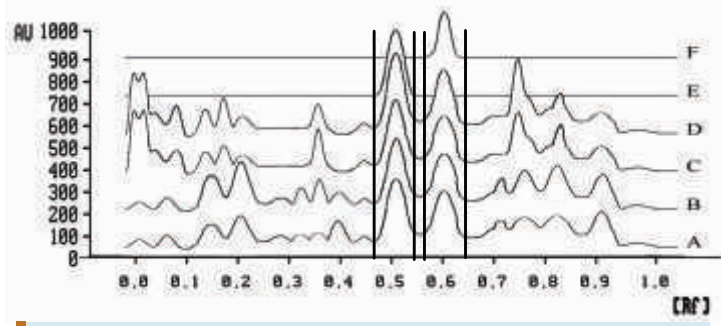


Figure 45 A: methanolic soxhlet extract of root, B: methanolic ASE 60°C extract of root, C: methanolic soxhlet extract of formulation, D: methanolic ASE 60°C extract of formulation, E: standard piperine, F: standard piperlongumine.

Usage of Suitable Substitutes in Herbal Drugs

The flowers of *Bombax ceiba* L. are known to be highly medicinal and two other species *Bombax insigne* Wall. and *Ceiba pentandra* are also known by the same vernacular names and are therefore many a times used as substitute. Hence authentication, quality and standardization of this drug were aimed using morphology, organoleptography and pharmacognostic markers. Flower samples were collected for two seasons and studied for their morphological characters, extractive values, fluorescence characters and quantitative estimation of carotenoids, anthocyanins and phenolic contents.

Phytochemistry

Generation of marker phytoconstituents and development of repository for quality standards of indian medicinal plants

Isolation of the reference standard compounds from 21 Indian medicinal plants was carried out under the project sponsored by ICMR. The isolated compounds were completely characterized by recording their physical and spectral data. Monographs of each of the compound were formulated in the prescribed format. All the physical and spectral data generated were included in these monographs. These monographs were published in the second volume of 'Phytochemical Reference Standards of Selected Indian Medicinal Plants' by Indian Council of Medical Research, New Delhi. The list of plants and the compounds isolated are shown in Table 22.

Table 22 List of compounds isolated from Indian Medicinal Plants

Sr. No.	Compound	Medicinal Plant/Plant Part
1.	Amarogentin	*Swertia chirayita* (Roxb. ex Fleming)/Whole plant
2.	Asclepin	Asclepias curassavica L./Root
3.	Asiatic acid	*Centella asiatica* L./Aerial part
4.	Bassic acid	*Minusops elengi* L./Stem bark
5.	Betaine	*Achyranthes aspera* L./Aerial part
6.	Capsaicin	*Capsicum annuum* L. var. annuum/Fruit
7.	Echinocystic acid	*Albizia lebbeck* (L.) Benth./Leaf
8.	Galangin	*Alpinia galangal* (L.) Willd/Rhizome
9.	Genistein	*Ougeinia oojeinensis* Hochr./Heart wood
10.	Hayatin	*Cissampelos pareira* L./Root
11.	Hecogenin	*Woodfordia fruticosa* (L.)/Flower
12.	Hederagenin	*Mimusops elengi* L./Heart wood
13.	Hesperidin	*Citrus aurantium* L./Fruit
14.	Indican	*Indigofera tinctoria* L./Leaf
15.	Malkanguniol	*Celastrus paniculatus* Willd./Seed
16.	Naringin	*Citrus sinensis* (L.)/Fruit
17.	Neriifolin	*Cascabela thevetia* (L.)/Stem bark
18.	Parkinsonin A	*Parkinsonia aculeata* L./Flower
19.	Tecoside	*Tecomella undulate* (Sm.)/Stem bark
20.	Valerenic acid	*Valeriana officinalis* L./Root
21.	Voacangine	*Tabernaemontana divaricata* (L.)/Stem bark

Development of Quality Standards of Indian Medicinal Plants

The ongoing activity in collaboration with the Botany Group of developing quality standards of Indian medicinal plants is also supported by ICMR. Under this programme the botanical and chemical standards of the medicinal plants are standardized. The chemical standardization of 11 medicinal plants was completed (Table 23). The monographs are published in volume 10 of 'Quality Standards of Indian Medicinal Plants' by Indian Council of Medical Research, New Delhi.

Table 23 List of monographs published in volume 10 of 'Quality Standards of Indian Medicinal Plants

Plant Name	Plant Part
Capparis spinosa Linn. var. *spinosa*	Fruit
Carthamus tinctorius Linn.	Flower
Crateva magna (Lour.) DC.	Stem bark
Curcurligo orchioides Gaertn.	Rhizome
Euphorbia hirta Linn.	Whole plant
Moringa oleifera Lam.	Leaves
Ocimum tenuiflorum Linn.	Seed
Oroxylum indicum (Linn.) Vent.	Root
Piper cubeba Linn. f.	Fruit
Ricinus communis Linn.	Leaves, Root and seed
Strychnos nux-vomica Linn.	Seed

Semiochemicals

The collaborative project 'Development, characterization and field evaluation of honeybee attractants for enhancing crop yields' is supported by Department of Biotechnology, Govt. of India in collaboration with University of Agricultural Sciences, Dharwad.

Field trials of honeybee lures

The field trials of formulations developed from plant based and pheromone based products for attracting honey bees were carried out on BT cotton (Bunny BG-I and Bunny BG-II) at University of Agricultural Sciences, Dharwad. Fruit boost, a commercially available bee attractant was used as a reference .All the formulations were found to enhance the bee visits to the flowers. Results of both the tests were in agreement. Results for Bunny BG-I were in agreement with the earlier results.

Screening of the essential oil of *Amomum subulatum* fruits on Indian honey bee *Apis florea*

The essential oil from *Amomum subulatum* fruits was isolated by hydrodistillation using Clevenger's apparatus. It was colourless sweet smelling volatile liquid. The constituents of the essential oil were identified by GC-MS analysis.

Bioassay of the essential oil on honeybees was initiated. The round table bioassay developed by us was used. The formulations of the essential oil in liquid paraffin were used for bioassay. It was found that the formulations of essential oil exhibited repellent properties at lower concentration towards the honey bee *Apis florea*. The formulations of higher concentration exhibited attractant properties. Confirmation of these findings is being made.

Environment Friendly Synthesis of Biomolecules

A crude enzyme was isolated from the fungus *Geotrichum candidum.* It was used for the reduction of carbonyl group of acetophenone. The product obtained showed different Rf from the starting material (acetophenone) on TLC and is being characterised. The crude enzyme obtained from *G. candidum* was found to show three peaks when analyzed by HPLC. It has been purified by gel chromatography using Sephadex G-100 as stationary phase and 0.1 N NaCl as the mobile phase. Applications of the purified enzyme are being investigated.

Stability Studies of Crude Plant Drugs

Stability study of the crude extract of *Adhatoda vasica* has been completed using the standard protocol. The stability up to 9 months was demonstrated. TLC and HPLC profiles of the extracts of *Phyllanthus amarus* and *Piper longum* stored under real time studies were developed and the stability of the extracts was confirmed.

Developmental Biology

New insights into the induction of secondary axis in hydra

The body of a hydra, a freshwater Cnidarian has a single oral-aboral axis and consists of a hypostome surrounded by tentacles, body column, bud(s) and foot. This axis is called the primary axis and any deviation in this axis due to formation of a new head or foot either through budding or through experimental grafting of a hypostome, peduncle or basal disc results in the formation of a secondary axis. The head organizer located in the hypostome and two morphogenetic gradients, head activator and head inhibitor gradients that run the length of the oral-aboral axis play essential roles in axis formation of hydra. A second organizer is located in the foot. When these two different organizer tissues are grafted together onto the middle part of a host, their inductive abilities are nullified. By using a labeled graft and an unlabeled host, it has been shown that cells from the host migrate into the secondary axis and support its growth. In the present study, secondary axis induction in hydra was used to understand pattern formation.

When a hypostome was grafted on a host of the same species or different species, a secondary axis was induced in 90% of the hosts. Length of the induced axis depended on the position of the graft along the host axis with respect to the host hypostome. Very small, moderate and full sized secondary axis was found to be formed in upper, middle and lower part of the body column, respectively. When host hypostome was cut off, a full sized axis is induced by the graft. This indicates the presence of a head inhibitor in the host hypostome which probably inhibits or at least curtails the secondary axis induction in its proximity.

When a foot was grafted on the host axis, secondary axis was induced with a sticky foot at the distal end. Size of the induced axis depended on the site of grafting along the host axis. When a foot was grafted in upper part of the body column, it caused an induction of a small secondary with a sticky foot at the distal end (Figure 46). Interestingly, the distance between host hypostome and induction caused by foot was found to increase till about day 4 post-grafting followed by a reduction that resulted in attaining the normal length by day 6 post-grafting (Figure 47). This could be due to active repulsion between the two organizing centers residing in the

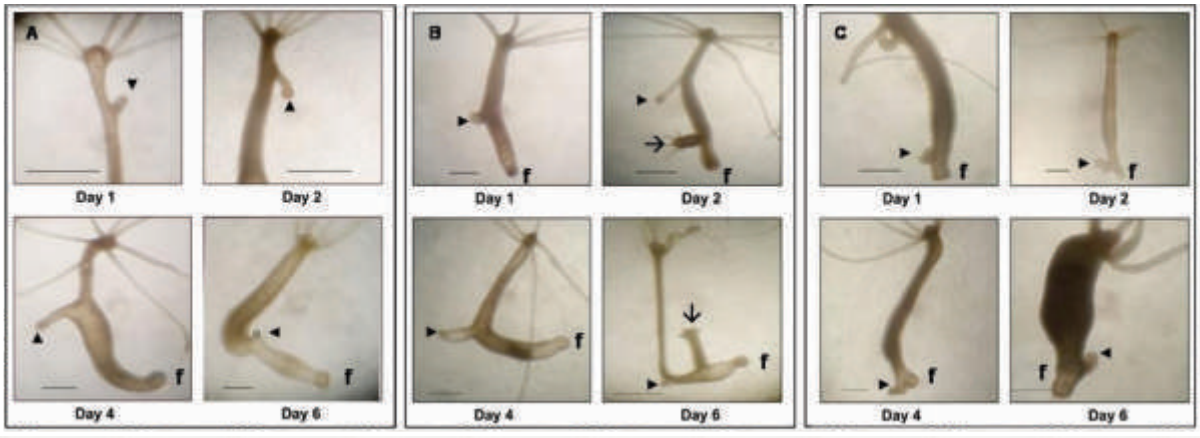


Figure 46 Grafting of a foot. A complete foot was isolated from host and grafted in upper, middle and lower part of the body column (A-C). Induction of small secondary axes with foot at their distal ends is indicated by arrowheads. Host foot is indicated by 'f'. Arrow indicates a bud. Scale bar = 1 mm

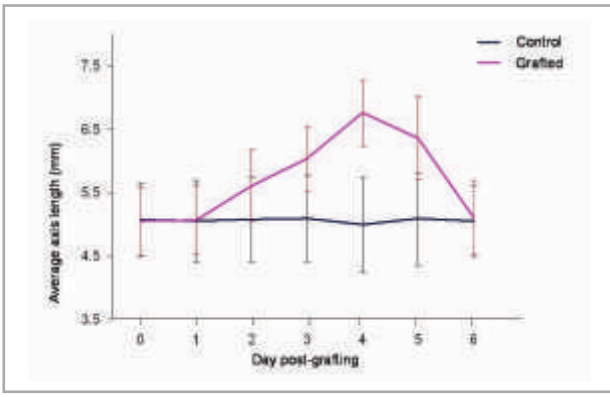


Figure 47 The effect of grafted foot on average length of the host. A complete foot was grafted in upper region of the host body column. The host hydra shows transient increase in the average length up to day four post-grafting. It attains normal length by day six post-grafting. Day 0 indicates the day of grafting

hypostome of the host and the grafted foot. When foot was grafted in the middle part of the body column, similar phenomenon of initial repulsion of the short induced axis from the host axis was observed. When the graft foot was transplanted in the lower part of the body column a new axis with very little or no body column was induced with foot at the distal end; these axes often got fused with the host foot. All the inductions caused by a foot transplant had a sticky, apparently functional foot at the tip. Removal of host hypostome did not influence the induction of secondary axis.

To understand the origin of cells contributing to the newly induced secondary axis, grafting experiments were carried out using transgenic *Hydra vulgaris* AEP hydra lines that express GFP in either the ectodermal cells or the endodermal cells as hosts and hypostome / foot from non transgenic *Hydra vulgaris* AEP hydra as grafts. It was found that the cells expressing GFP from the host moved into the growing secondary axis (Figure 48). It was also observed that the transplant cells get replaced slowly by host cells as secondary axis grows.

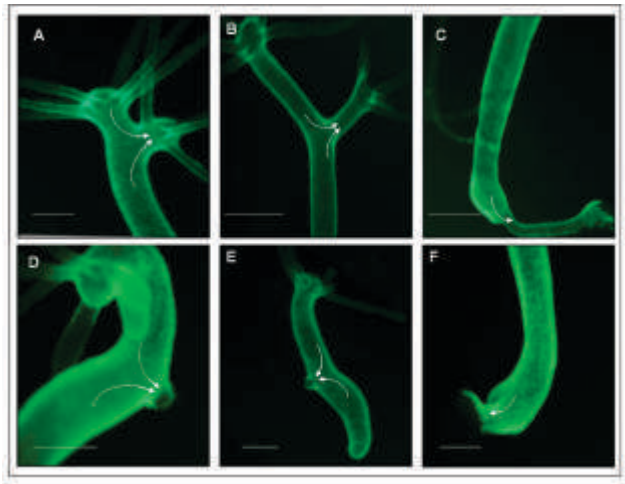


Figure 48 Contribution of host cells to the secondary axis. H. vulgaris (AEP) expressing GFP either in its ectodermal or endodermal cells were used as hosts and non GFP expressing transplants (a piece of hypostome or a complete foot) were grafted to induce secondary axis. A piece of hypostome (A-C) and complete foot (D-F) were grafted in the upper, middle and lower parts of the host body column. In all cases, ectodermal and endoderm supports the growth of the secondary axis

Phylogenetic characterization of common hydra from India

Although hydra has been extensively used as a model system in biology, there has been considerable uncertainty over its taxonomy, primarily due to lack of taxonomically distinct features. In India, a local species referred to as *Pelmatohydra oligactis*, is being used as a model system for studying regeneration, pattern formation and development. It has so far been referred to as *P. oligactis* based on a personal communication between late L. H. Hyman and late Leela Mulherkar. However, a detailed taxonomic study of Pune hydra ecotype, especially in view of the prevailing principles of hydra taxonomy, has not been carried out. With increasing use of this organism as a model system, it was necessary to describe the taxonomic position and phylogenetic relationship of Indian hydra with other species of hydra.

Polyps collected from a local pond were grown in the laboratory and their body length was measured by placing a graph paper under the glass beaker containing the animals. Randomly selected budding hydra were

used to study the pattern of emergence of tentacles and nematocyst morphology. Total DNA isolated from 50 clonal polyps was used to amplify regions of mitochondrial 16S rRNA gene. PCR product was sequenced and a 379 bp sequence was compared with the reported mitochondrial 16S rRNA sequences from other hydra species. Phylogenetic tree was constructed by neighbour joining (NJ) method based on p-distance using MEGA 4.0 software19.

It was observed that the polyps are light brown after feeding and pale or white upon starvation and measure 4–8 mm in the relaxed state. Individual body column is without a distinct stalk and 5-6 tentacles which are shorter than body column in normal conditions and can extend a little longer than the body column when stretched (Figure 49a-c). On the nascent buds, tentacles emerged asynchronously; two tentacles emerged first, opposite each other, followed by two more perpendicular to the first pair, whereas the fifth one appeared randomly (Figure 49d-g). Several types of nematocysts including pyriform stenoteles (Figure 49h), paramecium-like and some cylindrical holotrichous isorhizae (Figure 49i), cylindrical atrichous isorhizae (Figure 49j) and small, pyriform desmonemes; (Figure 49k) range in size from 4 -10 µm. The tubule is transversely coiled in holotrichous isorhiza (Figure 49i).

Usual mode of reproduction is asexual by budding. Sexual reproduction is rarely observed and the conditions under which gonads are induced are not clear. Polyps are dioecious in nature and many male gonads are found on the body column starting from just below the sub-hypostomal region to the budding zone. The testes are broadly triangular in shape with a slightly constricted apex, without a distinct nipple. They are alternately and spirally arranged on the body axis (Figure 49b). More than one female gonads occur along the axis starting from the sub-hypostomal region to budding zone.

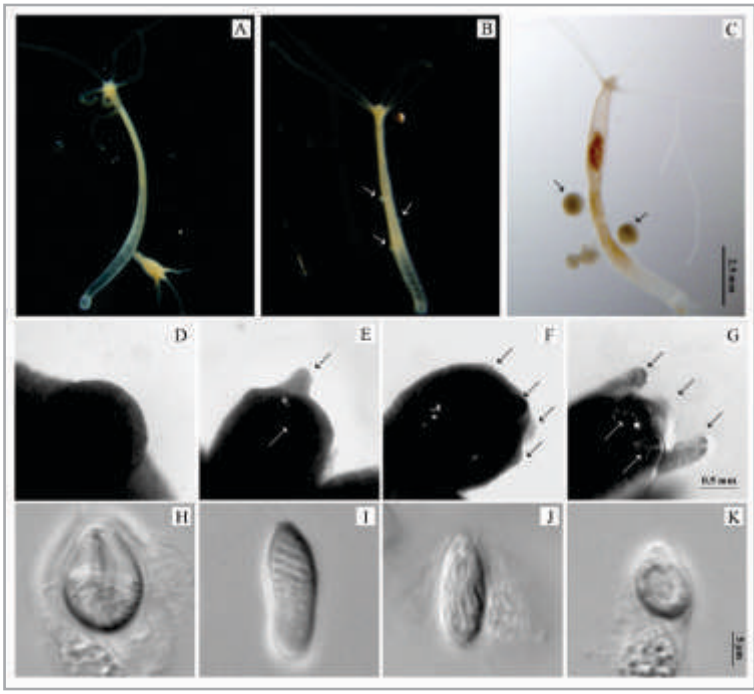


Figure 49 a–c, Hydra vulgaris Ind-Pune. a, Polyp with bud; b, Polyp with testes (→) and c, polyp with female gonads (→). d–g, Asynchronous emergence of tentacles on bud: d, No tentacles; e, Two tentacle rudiments (→); f, Both pairs of tentacle rudiments (→) and g, Two big and three small tentacle rudiments (→). h–k, Nematocysts: h, Stenotele; i, Holotrichous isorhiza; j, Atrichous isorhiza and k, Desmoneme. Scale bar: a–c = 2.5 mm, d–g = 200 µm and h–k = 5 µm

Phylogenetically *H. vulgaris* Ind-Pune has characteristic morphological features of the *H. vulgaris* species, such as absence of a distinct stalk, the length of stretched tentacles equal to or slightly longer than the body axis and the transversely coiled pattern of tubule within the holotrichous isorhiza. The asynchronous emergence of tentacles on buds is the only feature it shares with *H. oligactis* (*P. oligactis*). Molecular phylogenetic analysis based on mitochondrial 16S rRNA clearly shows its close affinity with members of common hydra *H. vulgaris* (Figure 50).

On the basis of evidence presented here, this hydra can be classified only as a different strain of the *vulgaris* species, particular to the type locality mentioned, and for further referencing we call it as *H. vulgaris* Ind-Pune. Our data show that *H. vulgaris* Ind-Pune is closely related to *H. magnipapillata* 105, whose genome has been sequenced.

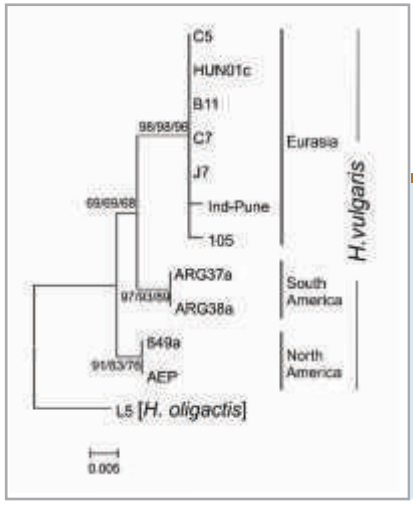


Figure 50 Phylogenetic tree based on 16S rRNA datasets using neighbour joining (NJ) method. Bootstrap values of NJ, maximum parsimony and maximum likelihood analysis are indicated above/ below each node. Branch lengths are proportional to the scale bars given in substitutions per site. C5, HUN01C, B11, C7, J7, 105, ARG37a, ARG38a, 849a and AEP are strains of *H. vulgaris*17; L5 is a strain of *H. oligactis*17 and Ind-Pune is the strain used in the present study

Neural development and disease

Glia play important roles in the development and maintenance of the nervous system. One of these includes wrapping neuronal cell bodies, axons to give rise to distinct functional units, and formation of the blood-brain-barrier. Using *Drosophila* as a model system, we are studying pathways that regulate morphogenetic changes in glia- a step essential for the process of ensheathment.

Fog is a secreted protein believed to signal via a G-protein coupled receptor to co-ordinate cell shape change essential for invagination of cells during gastrulation. Fog is also expressed in a subset of glia and regulates glial morphogenesis in the embryonic central nervous system. To identify signaling pathways and genes that interact with Fog, we have carried out a targeted RNAi based genetic screen. We have screened 200 GPCR RNAi lines corresponding to approximately 113 genes. This has identified multiple suppressors and enhancers of Fog signaling. A subset of these RNAi lines, was expressed specifically in glia, and the progeny were screened for lethality and/or behavioural defects. Of the 60 lines screened, expression of only 3 lines caused lethality, which suggests that of the 113 genes only a subset may be relevant to glial function.

We are also using *Drosophila* to understand the cellular function of *dVAP33A*. This gene encodes a transmembrane protein present in the endoplasmic reticulum. A mutation in the human ortholog of this gene is known to cause motor neuron disease or ALS. VAP is known to interact with FFAT motif containing proteins. This interaction is found to be conserved from yeast to mammals. We have used bioinformatics to identify all likely FFAT motif containing proteins in *Drosophila*. Scores were based on the degree of conservation of the motif with the highest score being 18.5 for the canonical motif. 47 proteins were thus identified with a score range of 18.5-15.1. Interestingly, a significant number of these proteins were found to be involved in membrane transport (Figure 51).

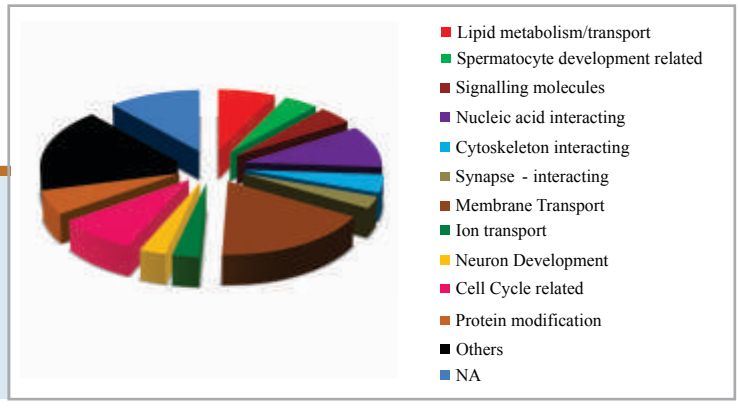


Figure 51 Broad categorization of FFAT motif proteins shows that they are involved in many cellular activities with a large proportion being membrane transport

Palaeobiology and Palaeontology

Quaternary

Late Quaternary environmental dynamics of southwest coast of India: evolution of wetlands and mangrove ecosystem

The stratigraphic record along with geochronological data has substantially helped making conceptual models of the evolution of various land forms along the southwestern coast. The landforms and their responses to sea levels and climate changes in the postglacial Early Holocene have brought in significant geomorphological reconstruction and also in extending our understanding of coastal processes. The main contribution to coastal evolution of Kerala has been focused on the evolution of the wetlands. Ashtamudi, Sasthamkotta and Chelupola lakes have been evolved from a large pre-Holocene basin consequent to incomplete / partial silting up during Early to Middle Holocene higher sea levels and high rainfall of the Holocene Climatic Optimum (HCO) of around 10000-7000 yrs BP. Similarly, the subsurface sedimentary architecture, geomorphologic set up of the Vembanad coast and the chronology of samples from its southern to the northern part indicate that the present day Vembanad Lagoon, the largest wetland system in south-western India, has evolved from an embayment of the Arabian Sea that existed prior to the Holocene. The sequence of Vembanad Lagoon formation in a four phased evolutionary model has been proposed (Figure 52). Further, occurrence of a bay head delta at the head of the Ashtamudi Lagoon, leaving some of its prominent upper arms into a discrete wetlands like Chittumalachira, Chelupola and Sasthamkotta lakes, has been reported (Figure 53).

The palynological and chronological data from the subsurface samples of coastal plains revealed that the mangroves of southern Kerala are essentially of Middle Holocene age. The ideal conditions for mangrove development along Kerala coast prevailed during Mid-Holocene times when the first extensive mangrove swamps developed in West Kallada/ Vembanad Lake area between 6250 and 3880 yrs BP. Such mangrove development seems to be of global significance as Mid-Holocene establishment of mangroves has been well recorded elsewhere when sea level got stabilized during this period. This period also coincides with the HCO when Monsoon Asia witnessed heavy precipitation. However, the mangroves responded to environmental changes due to freshwater influx into the system controlled by monsoon rainfall during Holocene leading to change in composition of species. The decline of mangroves since 3500 yrs BP and further degradation except at Kallada region have been attributed to the prevailing arid climate and weakening of monsoon until 1500 yrs

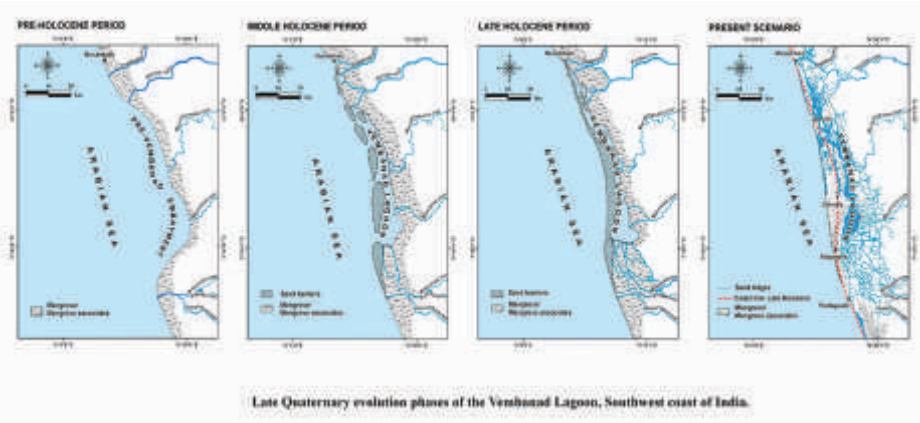


Figure 52
Late Quaternary evolutionary phases of Vembanad Lagoon, Southwest coast of India

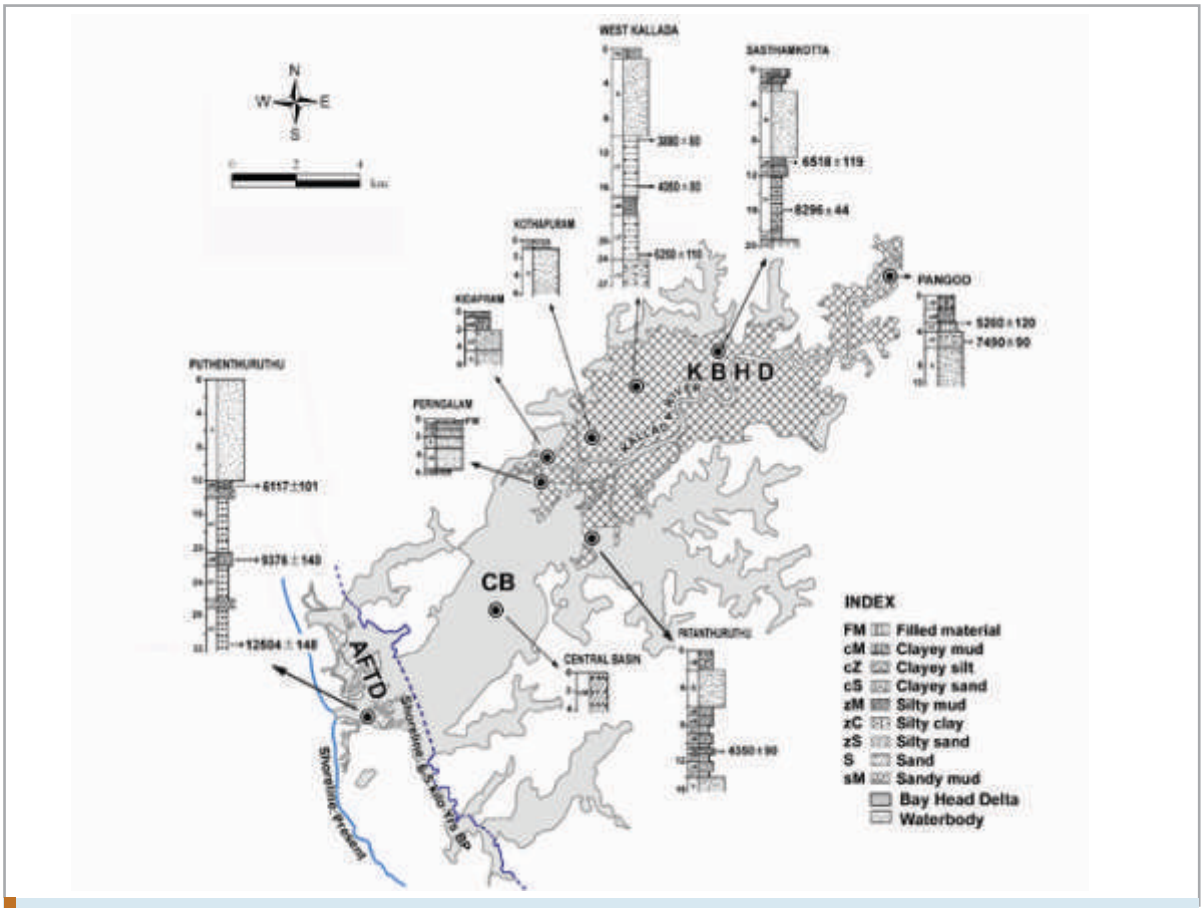


Figure 53 The Kallada Bay Head Delta developed in the head of the Ashtamudi Lagoon. Note the shoreline position of 6-5 kilo yrs BP and the present. AFTD Ashtamudi flood tide delta; CB Central Basin.

BP. Mangrove development and sustenance since Holocene in West Kallada may be due to steady flow of fresh water and gradual development of deltaic conditions. Our observation points to the fact that West Kallada has excellent potential for the rehabilitation of mangroves.

Environmental significance of mangrove foraminifera of coastal Maharashtra

The anthropogenic contribution to climate and environmental change has been a highly debated topic at all forums. This project has been initiated for two reasons: 1. Intertidal/marsh foraminifera have been known to be extremely sensitive to sea-level fluctuations. 2. Despite their utility, Foraminifera from Indian mangroves have never been studied before.

Work was initiated in January 2012 with sample collection in the Kundalika Estuary (Figure 54a), Raigad District, in February 2012. Prolific illegal sand mining was noticed in the middle and upper reaches of the estuary, within the river channel as well as along the banks. Retention walls have been constructed almost all along the river channel, at about 100m from the low tide level, restricting/deforesting the mangrove vegetation. Whilst the presence of mining rejects is visible in the habitats at the mouth of the estuary, release of effluents from fertiliser and chemical industries in the upper reaches of the estuary, was reported by local people.

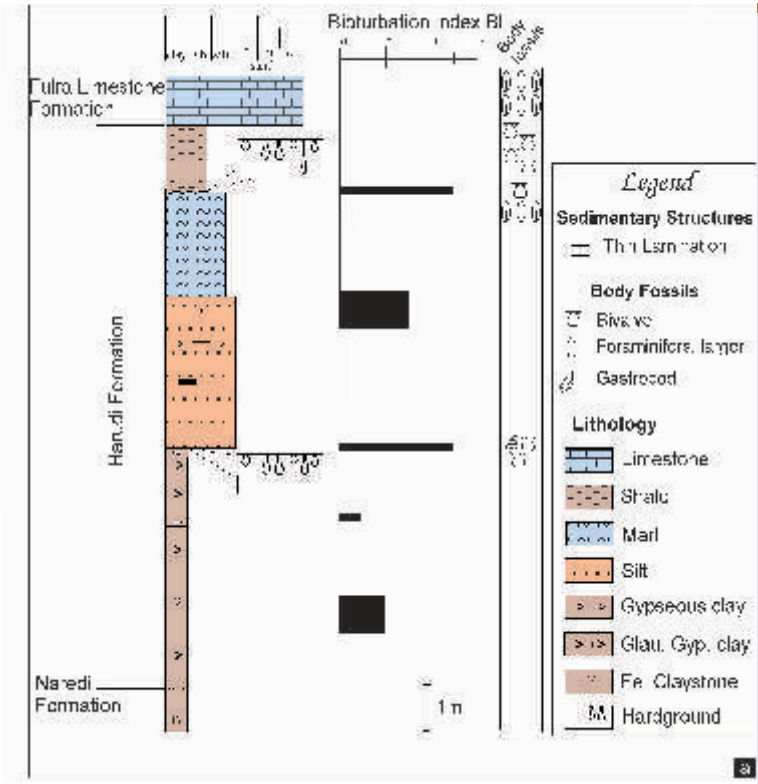
Samples were collected in the intertidal mudflats, along three transects namely the lower (Figure 54b), middle (Figure 54c) and upper reaches (Figure 54d) of the estuary. The surface samples have been processed and are ready for foraminiferal investigations. The 80 cm long core collected at the mouth of the estuary (Figure 54e&f) has been sub-sampled at 2 cm intervals (Figure 54g) for further investigations. The other 55 cm core collected in the upper reaches of the estuary has revealed some explicit neo-ichnological material. The top portion of the core bears several 1-1.5 mm burrows, most of which are filled with pellets. The walls of some of these burrows also show annulations. The importance of these neo-ichnological observations is being investigated.

Figure 54 a. Map of the study area, showing the sampling locations; b. Mudflats in lower reaches, Revdanda; c. Mudflats in middle reaches near Chordhe village; d. Mudflats in upper reaches near Shedsai village; e. Sediment core being extracted on the tidal flat at Revdanda Jetty;f. The 80 cm sediment core split-open; g. Sediment core being sub-sampled at 2-cm interval

Ichnology

Paleogene rocks of Kachchh

Ichnologic analysis of the Paleogene sediments of Kachchh resulted in the identification of 27 ichnospecies, distributed variously in the Naredi, Harudi, Fulra Limestone and Maniyara Fort formations. These 27 ichnospecies are categorized into six ichnocoenoses, viz. 1) *Thalassinoides* ichnocoenose, 2) *Gastrochaenolites* ichnocoenose, 3) *Schaubcylindrichnus* ichnocoenose, 4) *Bichordites* ichnocoenose 5) *Entobia* ichnocoenose, 6) *Palaeophycus-Skolithos* ichnocoenose. These six ichnocoenoses represent various parameters of environment. The Bioturbation Index (BI) logs superimposed on the lithologs for each formation have helped in identifying numerous ichnologic events during the Late Palaeocene to Oligocene times.



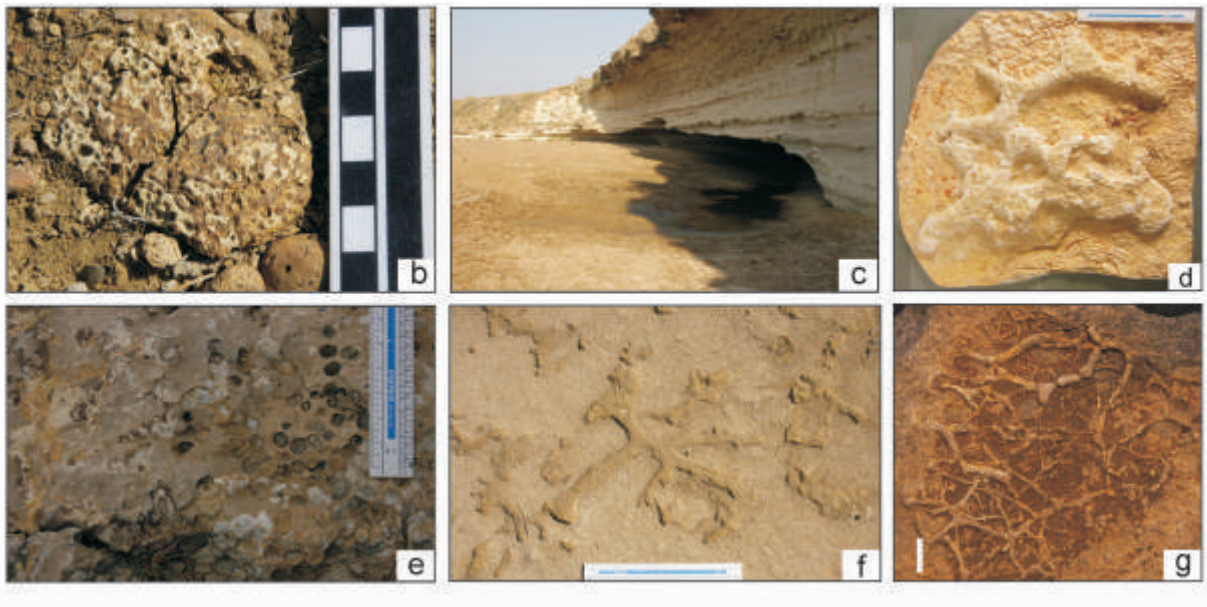


Figure 55 a. Lithosection of Harudi Formation, section measured west of Naliya-Narayan Sarovar Road, near km stone 217; b. Field expression of hardground. Calcareous clay showing *Gastrochaenolites* borings; c. Exposures of Fulra Limestone Formation forming cliffs along Rakhadi River, near village Kharai; d. Artificial FRP replica of large *Thalassinoides*network, Fulra Limestone Formation. Scale measures 30 cm; e.Clavate borings *Gastrochaenolites* drilled into coral skeletons, Coral Limestone Member, Maniyara Fort Formation, Walsara waterfall section. Scale: 1 division = 10 mm; f. *Thalassinoidessuevicus*burrow showing 'Y' branching, BerMoti Member, Maniyara Fort Formation. Scale measures 30 cm; g. Natural steinkern of sponge boring *Entobiageometrica* within Claystone bed of BerMoti Member, Maniyara Fort Formation. Bar scale = 10 mm

Sixteen major ichnologic events are identified throughout the entire Paleogene outcrops. These events are attributed to the sea level changes and corresponding fluctuations in environment of deposition during the Paleogene period, more precisely during Late Paleocene to Oligocene times. The duration of each event, however, varies considerably.

The commencement of the marine Tertiary is marked by an ichnologic event followed by three more major bioturbation phases within the Naredi Formation. In the Harudi Formation three events can be seen which include hardground ichnofauna at two levels (Figure 55a). The presence of hardgrounds in the Harudi Formation (Figure 55b) is an indicator of stratigraphic breaks of significant duration in what generally seems to be a continuous succession. Bioturbation is fairly persistent in the Fulra Limestone Formation (Figure 55c) and three major event zones with BI of 4-5.They are suggestive of slow rates of deposition permitting biogenic reworking of the sediments as evidenced by the long, horizontal mazes of burrows (Figure 55d). Within this formation numerous bioturbation events of secondary level are also present. Within the Maniyara Fort Formation six ichnologic events have been identified (Figure 55e,f,g).

It is, therefore, surmised that the limited thickness of the Paleogene sediments can be attributed to both, breaks in sedimentation evinced by hardgrounds as well as several high stand levels marked by intensely bioturbated zones. But the uneven distribution of bioturbation indicates repeated oscillation in the deposition of Paleogene rocks.

Mesozoic – Jaisalmer Formation, Rajasthan

The Jaisalmer Formation is Batho-Callovian in age and consists of five members viz., Hamira, Joyan, Fort, Bada Bagh and Kuldhar.

The ferruginous sandstones, containing abundant wood fragments, of Lathi Formation are overlain by clay-sandstone interbeds of lowermost Hamira Member, Jaisalmer Formation near the village Thaiyat. Two beds containing abundant turritellids (Figure 56a) are a part of the clay-sandstone interbeds.

All other beds of this sequence, apart from a red sandstone bed containing *Skolithos* and the topmost sandstone bed showing abundant development of *Arenicolites*, are devoid of bioturbation. This sequence is overlain by rippled calc-arenites exhibiting *Cochlichnus* and massive calc-arenites with *Rhizocorallium*, thus indicating that deposit feeding strategy followed suspension or filter-feeding mode burrows as the deposition progressed, representing a change in the ethology of the organisms. From the disposition of these burrows it can be interpreted that there was lowering of energy conditions from base to the top of this sequence.

Exposures of Joyan Member near Suleiman Pir and Soron ki Dhani exhibit a variety in the ethological classes. The mixed fauna consisting of the ichnogenera *Arenicolites, Asteriacites, Chondrites, Cylindrichnus, Diplocraterion, Gyrochorte, Hillichnus* (Figure 56b), *Laevicyclus, Rosselia, Protovirgularia* suggests tiering.

A few additional observations about the contact between Bada Bagh and Kuldhar Member include an abrupt lithological change (Figure 56c) from the thinly laminated sandstone containing *Gyrochorte*, *Protovirgularia*, *Lockeia*, *Palaeophycus*, representing the top of Bada Bagh Member to oolitic, calcareous arenites with abundant shell hash containing *Ophiomorpha* and *Planolites* (Figure 56d). The oolitic nature of calcareous arenites typically identifies them as beds of Kuldhar Member. The contact also exhibits an abrupt change in ichnofauna, from repichnia dominant to domichnia dominant.

Lateral variation in the lithology of Kuldhar Member was noted from Baramsar and Baisakhi in the North to Jajiya in the South. Rocks around Jajiya represent characters of deposition below storm wave base supported by large wave ripples along with intense *Rhizocorallium* bioturbation normally within the troughs (Figure 56e,f). A variation in the ichnofauna was also noticed. The beds at Baramsar and Baisakhi consist of *Asterosoma, Rosselia, Thalassinoides, Rhizocorallium, Gyrochorte, Arenicolites*, etc. while, the rocks at Jajiya include *Rhizocorallium, Palaeophycus, Skolithos, Chondrites* (Figure 56g) and *Planolites.*

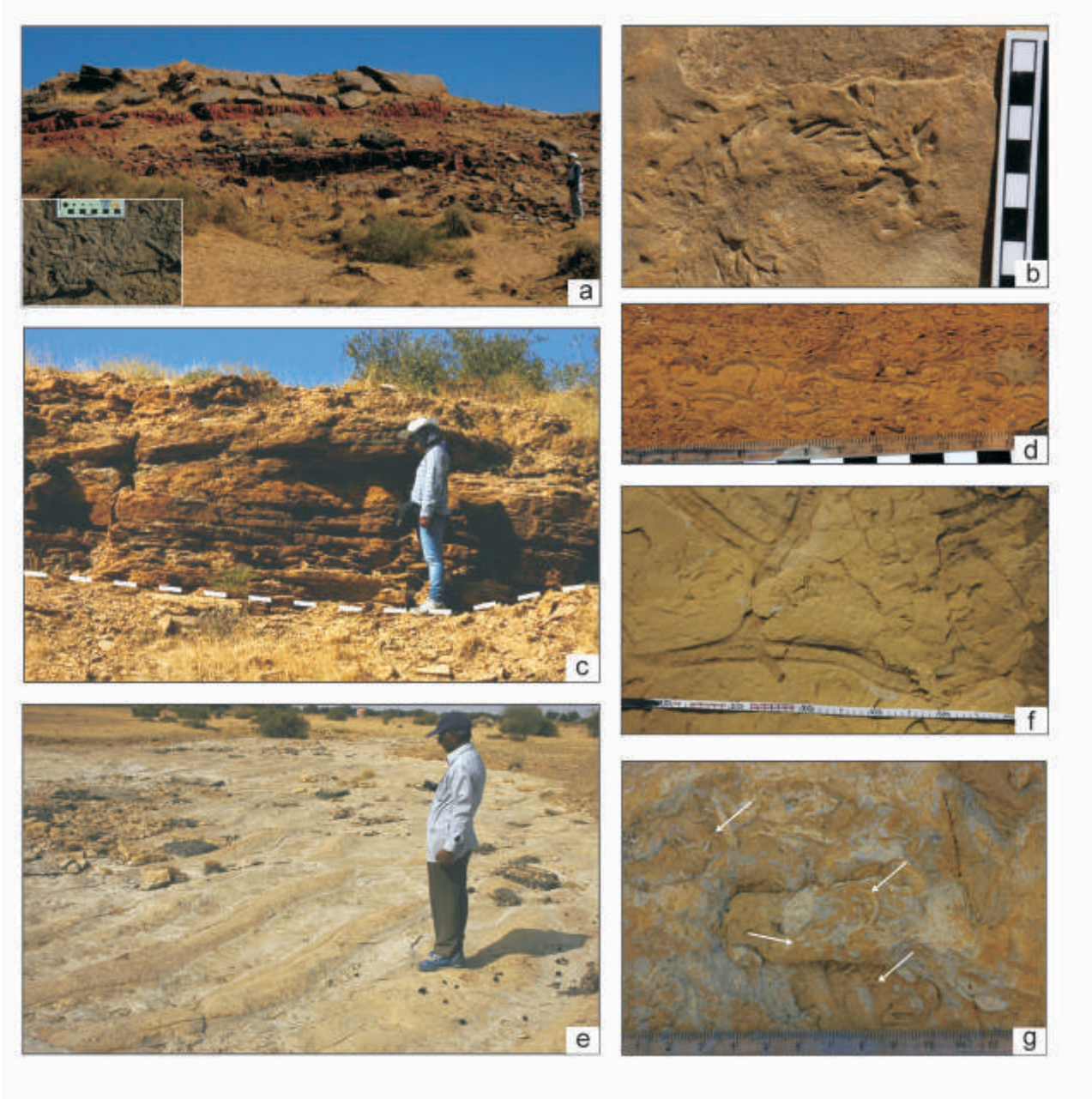


Figure 56 a. Hamira Member exposed along the slopes of a ridge near Basanpir. Inset shows Turritellid bed. Person is 156cm tall; b. Ichnogenus*Hillichnus* from the rippled calcarenite of Hamira Memberexposed near Suleiman PirDargah; c. Contact between Badabagh Member and Kuldhar Member marked by distinct change in lithology (dotted line). Scale: Person is 145 cm tall; d. Close-up of ooliticcalcarenites of Kuldhar Member showing abundant shell hash; e. Large wave ripplesin the calcarenite of Kuldhar Member exposed near Jajiya village. Person is 160 cm tall; f. *Rhizocorallium* within the troughs of large wave ripples of Kuldhar Member; g. *Chondrites* (arrows) in calcarenite of Kuldhar Member exposed near Jajiya village

Inter-Institutional Collaborative Projects

Digitized inventory of medicinal plant resources of Maharashtra. Collaborative network project sanctioned by Rajeev Gandhi Science & Technology Commission, Mumbai. VS Ghate, AS Upadhye

Study of pheromones and semiochemicals. Collaborating Institute: CBRTI, Pune. Dr DG Naik (ARI) and Mr MT Wakode (CBRTI)

Study of semio-chemicals for mealy bug control. Collaborating Institute: Dr DG Naik (ARI) and Dr K Banerjee (NRC)

SPONSORED PROJECTS

Sr No 1	Project Code 2	Project Title 3	Division 4	Sponsored by 5	Grant Received 6	Investigators 7
1	ARI/SP/001	All India Co-ordinated Research Project on Soybean (1.4.1968 onwards)	ICAR, New Delhi	G.B.Halvankar S.P.Taware	Plant Science	3078692
2	ARI/SP/002	All India Co-ordinated Fruit Improvement Project (1.10.70 onwards)	ICAR, New Delhi	S.C.Misra	Plant Science	2355000
3	ARI/SP/003	All India Co-ordinated Wheat Improvement Project (1.4.1972 onwards)	ICAR, New Delhi	S.C.Misra	Plant Science	4095000
4	ARI/SP/033	Production of Soybean Breeder Seeds of Annual Oil Seed Crops (2.2.88 onwards)	ICAR New Delhi	G.B.Halvankar S.P.Taware	Plant Science	-
5	ARI/SP/034	Front-line Demonstrations of Annual Oil Seed Soybean(21.2.89)	ICAR New Delhi	G.B.Halvankar S.P.Taware	Plant Science	17147
6	ARI/SP/043	Front-line Demonstrations in Wheat(1.4.1993 onwards)	ICAR, New Delhi	S.C.Misra	Plant Science	55171
7	ARI/SP/096	Wheat Breeder Seed Scheme		Misra S.C.	Plant Science	-
8	ARI/SP/108	The Utilisation of Carbon Isotope Discrimination (CID) and Ash Content to Select Wheat For Higher Tolerance to Water Limitation in Peninsular Zone of India(1.11.2003)	IAEA Vienna	S.C.Misra	Plant Science	-
9	ARI/SP/118	Collaborative Multi locational evaluation for Bread wheat germplasm by NBPGR (March-2006 onwards)	ICAR,Karnal	S.C.Misra, B.K.Honrao	Plant Science	134813
10	ARI/SP/119	Need Base Research on Testing Centres of Sesame & Niger (10.2.2005 onwards)	I.C.A.R. Jabalpur	S.P.Taware	Plant Science	-
11	ARI/SP/124	NANO CET(11.8.2005 to	Nano Cutting Edge Technology	K.M.Paknikar	Microbial Sci.	-
12	ARI/SP/126	Development of Naphthalene Derivaties for Drug Discovery 27.7.2005 to 26.7.2008	A.J.Organica Pvt.Ltd., Pune	Dr. D. G. Naik	Animal Sci.	125000
13	ARI/SP/142	Identification diagnosis and characterization of polyviruses infecting chilli/capsicum (Capsicum annum L.) in Maharashtra and their integrated management(25.1.2007 to 24.1.2010)	D.S.T. New Delhi	Satya Prakash	Animal Sci.	39000

Sr No 1	Project Code 2	Project Title 3	Division 4	Sponsored by 5	Grant Received 6	Investigators 7
14	ARI/SP/144	Resource generation on Biodiversity for the development of CD's,kits and posters(02.03.2007 onwards)	D.S.T.V.P. New Delhi	Madhav Gadgil	Plant Science	-
15	ARI/SP/148	Isolation, identification and development of methanogens for in situ generation of methane from oil reservoirs(1.1.2007 to 30.06.2010)	ONGC	D.R.Ranade P.K. Dhakephalkar	Microbial Sci.	402000
16	ARI/SP/149	Generation of marker phytoconstituents and development of Repository for quality standards of Indian Medicinal Plants (30.3.2007 to 30.12.2011)	ICMR New Delhi	D.G.Naik	Plant Sci.	262564
17	ARI/SP/152	WOS-B Scheme on behalf of S & S Division(7.9.2007 to 6.9.2012)	DST New Delhi	S.Rao	Animal Science	-
18	ARI/SP/155	Development characterization and field evaluation of honeybee attractants for enhacing crop yields (13.9.2007 to 31.3.2012)	DBT New Delhi	D.G. Naik	Animal Science	-
19	ARI/SP/156	Collaberative Research on Development of Yeast or other suitable microbial systems with surface bound expression on genes encoding nitrilase monooxygenase and lipase and improvement of the thermal tolerance of these enzymes by site directed mutagenesis (1.12.2007)	Hi-Tech Bio Sci.India Ltd. (HTBSIL)	P.K. Dhakephalkar	Microbial Sci.	-
20	ARI/SP/157	Bioproduction of Lichen metabolites and their antimicrobial, antioxidant, cardiovascular-protective and anti-tumor activities in vitro (12.11.2007 to 11.11.2010)	DBT New Delhi	B.C.Behra	Plant Science	266000
21	ARI/SP/160	National facility for culture collection of fungi (3.3.2008 to 2.3.2013)	DST New Delhi	S.K.Singh	Plant Science	6000000
22	ARI/SP/164	Sorghum grain sample analysis (30.4.2008 to 31.3.2012)	NRCS ICAR		Animal Science	-
23	ARI/SP/166	Generating new wheat germplasm with enhanced draught/heat tolerance using AB genomes genetic diversity(15.10.2008 To 15.10.2011)	World Bank	S.C.Misra	Plant Science	1514519
24	ARI/SP/168	Digitized Inventory of medicinal plant resources of Maharashtra (16.2.08 to 15.2.2012)	RGST Commission	Mrs. V.S. Ghate	Plant Science	7371235
25	ARI/SP/169	Development of blends and composites based on biodegradable polymer of microbial origin (24.3.2009 to29.6.2012)	DBT New Delhi	Mrs. P.P. Kanekar	Microbial Science	279915
26	ARI/SP/170	Accredited Test laboratory (ATL) under the national certification system for Tissue culture raised plants(12.2.2009 to 28.2.2013)	DBT New Delhi	S. A. Tamhankar	Plant Science	43000
27	ARI/SP/172	Quality standards of Indian Medicinal Plants (16.4.2009 to 15.4.2011)	ICMR New Delhi	D.G.Naik	Plant Science	773583

Sr No 1	Project Code 2	Project Title 3	Division 4	Sponsored by 5	Grant Received 6	Investigators 7
28	ARI/SP/173	Exploration of pristine and extreme habitats for themophilic anaerobes and their enzymes for industrial applications(12.8.2009 to 11.8.2012)	SERC	P.K. Dhakephalkar	Microbial Science	1205916
29	ARI/SP/175	Stability studies of Crude Plant Drugs(22.9.09 to 31.3.12)	NMPB Ayurveda	Pratibha Shrivastava	Plant Science	750000
30	ARI/SP/176	Biodegradation of Nitroexplosive (14.10.09 to 13.10.2012)	DBT New Delhi	P.P.Kanekar	Microbial Science	-
31	ARI/SP/177	Bioaugmentation process for treatment of Wastewater to reduce COD and ammoniacal nitrogen in discharged effluent (1.10.09 to 31.3.12)	Enviro Technology Ltd	Mrs. P.P. Kanekar	Microbial Science	180000
32	ARI/SP/178	Development of environmentally benign nanomaterial-based enzyme formulation for biocontrol of Plant pathogens and PESTS (1.9.2009 to 31.8.2012)	DBT New Delhi	K.M.Paknikar	Microbial Science	570000
33	ARI/SP/179	Mobilizing Qtl/Genes for quality Traits into high yielding Wheat varieties Through Marker- Assisted Selection(23.09.2009 to 22.09.2014)	DBT New Delhi	S. A.Tamhankar	Plant Science	-
34	ARI/SP/180	Marker Assisted selection for development of kunitz TRYPSIN inhibitor free SOYBEAN varities (29.9.2009 to 28.9.2014)	DBT New Delhi	PhilipsVergheese Manoj Oak	Plant Science	-
35	ARI/SP/181	Molecular marker assisted development of biotic stress resistant wheat varities (13.11.2009 to 12.11.2014)	DBT New Delhi	S. A.Tamhankar	Plant Science	-
36	ARI/SP/182	Metwork -Project- Draught Tolerance in Wheat- Phenotyping for adaptive mechanisms to facilitate MAS based wheat breeding (23.11.2009 to 31.03.2012)	ICAR Karnal	Misra S.C.	Plant Science	149579
37	ARI/SP/183	Network -Project- physiological Water use efficiency (root Trains) (23.11.09 to 22.11.12)	ICAR Karnal	Misra S.C.	Plant Science	72848
38	ARI/SP/184	Developing Community based approach for prevention and management of Anemia through nutritional inputs and awareness among young rural women in India (1.12.09 to 30.11.11)	DST New Delhi	Mrs. S.Rao	Animal Science	-
39	ARI/SP/185	Recovery of Ret Species of Ceropegia from Western GhatsBT/ PR-9456/BCE/08/572/2007 (10.01.2010 to 09.01.2015)	DBT New Delhi	V.S.Ghate	Plant Science	-
40	ARI/SP/186	Importance of reactive OXYGEN species in early chick embryonic development (2009/37/52/BRNS/3299) (7.04.2010 TO 6.4.2013)	Dept.of Atomic Energy (DAE) Mumbai	S.M.Ghaskadbi Vidya Patwardhan	Animal Science	324000

Sr No 1	Project Code 2	Project Title 3	Division 4	Sponsored by 5	Grant Received 6	Investigators 7
41	ARI/SP/187	Phenotypic Characterization of Plasmids(13.04.10 to	Shree Bacteriological lab,Jalgaon	P.K. Dhakephalkar	Microbial Science	-
42	ARI/SP/188	Epigenetics of Regeneric in Hydra (BT/01/COE/09/07 (19.03.2010 TO 18.03.2015)	DBT New Delhi	S.M.Ghaskadbi	Animal Science	-
43	ARI/SP/189	Transgenic Hydra Facility for the Study of Molecular Regulation of Regeneric and Pattern Formation (BT/01/COE/09/07) (19.03.2010 to 18.03.2015)	DBT New Delhi	S.M.Ghaskadbi	Animal Science	-
44	ARI/SP/190	Folded Gastrulation -An insight into Mechanisms regulating glial morphogenesis and axonal ensheathment in Drosophila BT/PR11497/BRB/10/658/2008 (26.03.2010 to 25.03.2013)	DBT New Delhi	Anuradha Ratnaparkhi	Animal Science	-
45	ARI/SP/191	Role of Copper in Alzheimer's Disease : An interaction of copper with AB peptideSR/S1/IC-03/2010 (2.8.2010 TO 1.8.2013)	DST New Delhi	Prasad Kulkarni	Animal Science	-
46	ARI/SP/192	Feasibility of Biohydrogen and Biomethane producing from Sago Industry Effluent using mixed microbial consortia in 2 stage fixed bed Anaerobic ReactorsBT/ PR13315/GBD/27/250/2009 (22.7.2010 to 21.7.2013)	DBT New Delhi	Biswarup Sen	Microbial Science	-
47	ARI/SP/193	Assesment of Health promoting and Disease preventing properties of Lactobacilli and their microencapsulation (11.8.2010 to 10.8.2011)	HTBIL	P.K. Dhakephalkar	Microbial Science	-
48	ARI/SP/194	The role of SG2NA in tissue differentiation during chick embryonic developmentSR/ SO/AS-37/2008-B (17.1.2011 TO 16.1.2014)	DST	S.M. Ghaskadbi	Animal Science	-
49	ARI/SP/195	Test study to validate exogeneous enzyme application for enhancement of biomethanation processBT/ COORD/MST/2006 (22.12.2010 TO 21.09.2011)	DBT	D.R.Ranade	Microbial Science	-
50	ARI/SP/196	Resistant starch enriched Probiotic supplement for inflammatory bowel disordersBT/PR/-14973/FNS/20/ 508/2010(15.3.2011 TO 14.3.2014)	DBT	S.S.Nilegaonkar	Animal Science	-
51	ARI/SP/197	RNAI based genetic screen to identify interactors of VAPB and their in VAPB mediated ALSBT/ PR-14223/MED/30/410/2010 (9.3.2011 TO 8.3.2014)	DBT	Anuradha Ratnaparkhi	Animal Science	-
52	ARI/SP/198	Molecular breeding and selection strategies to combine and validate Qtl's for improving WVE and heat tolerance in Wheat (New GCP) upto 31.12.2011	New GCP	Dr.S.C.Misra	Plant Science	51922

Sr No 1	Project Code 2	Project Title 3	Division 4	Sponsored by 5	Grant Received 6	Investigators 7
53	ARI/SP/199	Development of two stage Anaerobic bactorial process for butanol production from Industrial Wastes(2.6.2011 to 1.6.2014)	DBT	Dr. Ranade B.Sen	Microbial Science	3718000
54	ARI/SP/200	Maharashtra Forest, Bhimashankar(23.02.2011 to 22.02.2012)	Forest			198000
55	ARI/SP/201	Women Scientist Scheme A (WOS-A) entitled "Documentation of mangrove forminifera of coastal Maharashtra with special reference to their environmental significance" (21.12.2011 to 20.12.2014)	DST	Dr. Rajani Panchang	Animal Science	620000
56	ARI/SP/202	"Molecular systematics, phylogeny and ecology of ceropegia L. (apocynaceae -asclepiadondeae) in India"(07.12.2011 to 06.12.2014)	SERB	Dr. Sachin Punekar		937000
57	ARI/SP/203	Molecular Investigation and Cultivation of Microbial Diversity Associated with Methane Hydrates with Special Emphasis on Energetics of Methanogenesis. (12.1.2012 to 12.2.2015)	ONGC	Dr. D.R.Ranade & Dr. P.K. Dhakephalkar		1526832
58	ARI/SP/204	Process for biomethane production from marine algae (7.3.2012 to 7.9.2013)	Reliance	Dr. D. R. Ranade		300000
59	ARI/SP/205	IRSONGC – Water Treatment (21.3.2012 to 21.3.2014)	ONGC			471528
60	ARI/SP/206	Biofertication of wheat for micronutrients through conventional and molecular approaches-Phase II (22.03.2012 to 21.03.2017)	DBT	Dr. S. A. Tamhankar		2280000
61	ARI/SP/207	National Network program on lichens: Bioprospecting its secondary compounds and establishing cultures and collections(21.03.2012 to 20.03.2017)	DBT	Dr. B. C. Behra		7977000
		Total				**48145264**

Committees

Agricultural Farm Management Committee

Dr DR Bapat, Chairman
Dr Mrs PP Kanekar, Acting Director
Dr BG Keskar, Member
Dr AS Summanwar, Member
Dr SC Misra, Member-Secretary

Institutional Animal Ethics Committee

Dr DR Ranade, Chairman
Dr CG Raut
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Institutional Bio-Safety Committee

Dr DR Ranade, Chairman
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Dr Vidya Gupta
Prof. Jayant Pal
Dr VG Patwardhan
Dr SA Tamhankar
Dr PK Dhakephalkar, Member-Secretary

Vigilance Officer

Dr SP Taware

Central Public Information Officer

Dr PK Dhakephalkar from 4.11.2009

Grievance Officer

Dr GK Wagh from 1.3.2010

Annexure

Repositories

Agharkar Herbarium at MACS (AHMA)

One thousand seven hundred and eighty specimens were added to AHMA after their taxonomic scrutiny, nomenclatural updation and entries on cards, register and database. These additions were done through routine botanical excursions, specimens received from Dr VD Vartak's personal collections and specimens deposited by PhD students. Eighty seven new additions were made to AHMA out of which 45 species are from Herbarium of New South Wales, Australia. Presently the total number of specimens in AHMA database is close to 26000 alongwith 1200 herbarium images. The development of image library based on photographs taken in the field tour is also continued. In future it is planned to tag this library with digitized AHMA package.

National Fungal Culture Collection of India (NFCCI-WDCM 932)

After verification of taxonomic identity, fungal strains are deposited in NFCCI. As part of conservation of fungal diversity, live, pure and authenticated cultures of 387 interesting fungi were added. The total number of fungal cultures comes to 2737 in NFCCI. The fungal germplasm are being maintained in culture collection by following standard long term preservation methods, like freeze drying, liquid nitrogen, glycerol and distilled water.

Ajrekar Mycological Herbarium (AMH)

The AMH holds 9454 fungal specimens and about 30,000 lichen samples. This herbarium contains several type materials of many noteworthy species of fungi and lichens reported from India.

MACS Collecton of Microorganisms (MCM)

Under this project, specialized cultures of microorganisms used in various processes are being maintained in active form and supplied to researchers on demand. The specialized cultures include standard reference cultures, cultures used in metal-microbe interactions and industrial waste treatment, extremophiles such as halophilic, thermophilic and methanogenic archaea, alkaliphilic cultures.

Fossil Repository

Fossil repository hosts 7895 specimens of plant and animal fossils. These include ammonoidea, bivalvia, gastropoda, bryozoa, echinoidea, foraminifera, trace fossils, plant fossils, pollens and spores collected from various localities from Peninsular India.

Knowledge Resource Center: Library

A local area network is dedicated to in-house activities. The library software has been recently upgraded to SLIM-21 version. The library provides on-line access to various scientific databases and access to E-journal resource published worldwide. The library maintains the institute website www.aripune.org. The Library and Information Centre is a member of 'National Knowledge Resources Consortium (NKRC)'. Current holdings of the Library are as under:

Particulars	Total	Particulars	Total
Books/Bound Volumes	26303	Maps and Atlases	562
Reference Books	1081	Microfilms/Fisches	636
PhD Thesis	268	Annual Reports	392
M Sc/M Phil Thesis	96	Journals	223

Services Rendered/ Offered

Crude Drug Authentication Service

ARI is rendering additional service for identification, authentication and voucher deposition of crude drug samples. During the period of report 160 crude plant drugs were authenticated and 25 vouchers of outside parties were deposited in crude drug repository.

Fungal Identification Service

Large numbers of fungal cultures, diseased samples were received from different research institutions, agricultural universities, private organizations and industries. Soil samples received were also analyzed for TVC/CFU and nematode counts. The identification services by conventional and molecular means were provided on nominal payment basis. Total 731 fungal cultures & 33 fungal samples, received from academic and research institutes across the country, were identified using morphological and/ or DNA sequencing. The identified fungi were largely belonged to mitosporic group apart from ascomycetes, basidiomycetes and zygomycetes. As such more than 128 centres in India were benefited, which includes 104 different academic and research institutes and 24 private centres. During period under report 107 different fungal strains were supplied to various academic and private organizations.

Consultancy Assignments undertaken

DR Ranade: To Tata Motors Ltd., Pune to bring out its book on 'Green Workshop' DR Ranade and PK Dhakephalkar: Large scale production, preservation and rejuvenation of microbial consortium for inhibition of enteropathogens and reduction of malodor associated with human excreta. Name of the company: Vikalpa Technology, Pune

Technical Services

Elemental analysis of samples was done for industrial houses.

Patents

Applications

Patent	Details	Inventor(s)
A microbial process for production of antifungal compound active against phytopathogenic fungi using a haloalkaliphilic bacterium Halomonas campisalis	611/MUM/2012	Kanekar PP, Borgave SB, Naik DG, Kelkar AS

Research Publications

(Monographs/ Book Chapters/ Research papers/ Bulletin/ Booklet)

Monographs

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Naik DG, Upadhye AS, Deshpande A and Dixit M. 2012. Quality Standards of Indian Medicinal Plants. Volume X. Monographs of 11 medicinal plants were published by ICMR, Government of India

Book Chapters

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Pore SD, Pendse ND, Ranade DR and Dhakephalkar PK. Exploration of pristine and extreme habitats for industrially important Alcohol dehydrogenase and Inulinase. 52nd Annual Conference of Association of Microbiologists of India (AMI), International conference on Microbial Biotechnology for Sustainable Development' Chandigarh, November 2011

Ramteke S, Ginotra YP, Kulkarni PP. Probing structure and function of amyloid beta peptide using pulse radiolysis. Workshop on Radiation Chemistry, NCFRR and Department of Chemistry, Pune, 1-2 February 2012

Sarnaik SS, Kanekar PP, Wagh GK, Bari S, Darji AM, Shah MP, Mathukiya H. Bioaugmentation process using microbial consortia for treatment of industrial wastewater from common effluent treatment plant (CETP). 52nd Annual Conference of Association of Microbiologists of India (AMI), International conference on Microbial Biotechnology for Sustainable Development, Chandigarh, November 2011

Thombre RS, Kanekar PP, Oak MD. Application of cyclodextrin glycosyl transferase produced by Exiguobacterium aurantiacum MCM B-1021 as an antistaling enzyme in bread making. XXI Indian Convention of Food Scientists and Technologists (ICFOST) on Innovations in Food Science and Technology to Fuel the Growth of the Indian Food Industry, Pune, January 2012

Vaidya HS, Naik DG and Mujumdar AM. Pharmacologically active formulations from Indian propolis. National Conference on Biodiversity Assessment, Conservation and Utilization, Abasaheb Garware College, Pune, 9-11 February 2012

International Conference on New Horizons in Biotechnology & 8th Annual Convention of the Biotech Research Society, Trivandrum, November 2011

Choudhari MK, Rajwade JM, Paknikar KM. Chitosan tagged magnetic nanoparticles based kit for rapid antimicrobial susceptibility testing and identification of pathogens

Agrawal S, Morarka A, Bodas D, Paknikar KM. Multiplexed detection of water borne pathogens in circular microfluidics

World Conference on Paleontology and Stratigraphy, Thailand, 28 November-2 December 2011

Kulkarni KG and Borkar VD. Evidences of a maximum flooding surface during deposition of the Bagh Beds (Turonian-Coniacian) India

Kulkarni KG and Sathe Vijay. Late Pleistocene molluscan fauna from a mammalian sites in Manjra valley, district Latur, Maharashtra, India

International Conference of XXI Indian Association for Angiosperm Taxonomy and National Seminar on Biodiversity Conservation and Climate Change, Institute of Minerals and Materials Technology, Bhubaneswar, Odisha, 2-4 December 2011

Rajput B. Micropropagation studies on critically endangered *Ceropegia mahabalei*

Kshirsagar P. Germplasm studies on some medicinal plants from Family Apocyanaceae

DST sponsored Brain storming session and National level field workshop on Geology of Kachchh basin, Western India: Present status and future perspectives, Bhuj, 26-29 January 2012

Kulkarni KG and Borkar VD. Status of palaeoichnology in Mesozoic of Kachchch: Insight into an opportunistic ichnotason from the Lower Cretaceous.

Borkar VD, Kulkarni KG and Kapoor S. Miocene mollusca: an overview

Poster Presentation

Badnikar AA, Bhagat RB and Taware SP. Evaluation of insecticidal potential of seed oils of some plants against pulse beetle, *Callosobruchus maculatus* L. National Conference on Biodiversity Assessment, Conservation and Utilization, Pune, 9-11 February 2012

Bhagwat MD, Chavan AM, Khade VM, Honrao BK and Misra SC. Use of alternative dwarfing genes in wheat improvement (*T. aestivum* L.). National Conference on Recent Trends in Plant Sciences and 21st APSI Scientist Meet, Baramati, Pune, 3-5 February 2012

Pramod Kumar, Mukherjee G and Singh SK. *In- silico* analysis of PKS of pigment producing *Monascus purpureus*. National conference on Mycodiversity with its Sustainable Exploration and Biotechnological Applications and 38th Annual Meeting of Mycological Society of India. Amravati, 6-7 February 2012

Varghese P. Soybean Breeding – New strategies for future challenges. National Seminar on New Frontiers in Plant Science Research for Sustainable Development, Khordha, 25-26 February 2012

XVIII INQUA Congress Conference, Switzerland, 21-27July 2011

Limaye RB, Kumaran KPN and Padmalal D. How did mangrove vegetation respond to Holocene sea level and climate changes along Konkan – Kerala coast of Southwestern India?

Padmalal D, Kumaran KPN, Nair KM, *Limaye RB*, Vishnu MS and Baijulal B. Late Quaternary evolution of Vemband lagoon in the southwestern coast of India: An appraisal of sedimentary record of sea level and climate change

Kumaran KPN, Limaye RB, Punekar S, Rajaguru SN, Karlekar SN and Joshi S. 2011. Plant fossil assemblage as climate archive in the Pleistocene deposits of Konkan, western India

Participation in Conferences/ Symposia/ Seminars/ Workshops

Dandge CN

99th Indian Science Congress, Bhubaneswar, 3-7 January 2012

Datar MN, Ghate VS

Biodiversity of Sahyadri - Protection and Conservation. Applied Environment Research Pune and Nisargamitra, Kolhapur, 13-14 September 2011

12th plan for Medicinal Plants need based requirements. Maharashtra Ayurvediya Aushadhi Utapadak Sangha (Medicinal plants providers, industries and growers Association), Vaidya Khadiwale Vaidyak Samshthan, Pune, 15 September 2011

Datar MN, Upadhye AS

Expert, Taxonomic updatement of medicinal plant garden. Tilak Ayurved Mahavidyalaya, Pune. 26-27 April 2011

Deoli V, Karandikar A

3 Day Intensive Workshop on Microscopy for Life Sciences, Pune, January 2012

Ghaskadbi S

Symposium, Population Genetics and Chromatin Dynamics. Banaras Hindu University,Varanasi, January 2012

XXXV All India Cell Biology Conference and Symposium on Membrane Dynamics and Disease, NISER, Bhubaneswar, December 2011

Ghaskadbi S, Ratnaparkhi A

Workshop on Developmental Mechanisms in Model Organisms, Jaipur, February 2012

Karkamkar S

51st Annual Conference of Maharashtra Rajya Draksha Bagayatdar Sangh, Pune, 1-2 October 2011

Kore P, Upadhye AS

Participatory Rural Appraisal (PRA) exercise on medicinal plants. Balasaheb Desai College, Patan, Satara, 14 August 2011

Kulkarni KG

World conference on Paleontology and Stratigraphy, Thailand, 28 November-2 December 2011

DST sponsored Brain storming session and National level field Workshop on Geology of Kachchh basin, western India: Present status and future perspectives, Bhuj, 26-29 January 2012

Kumar P

Workshop, Genes to Genomes: bioinformatics approaches (G2G), Pune, 12-15 December 2011

Kumbhalkar B

Current Trends in Medicinal Plant Research, University of Pune, 10-13 January 2012

Limaye RB

XVIII INQUA Congress Conference, Switzerland, 21-27 July 2011

Misra SC, Honrao BK and Oak MD

50th All India Wheat & Barley Workshop, New Delhi, 1-4 September 2011

Naik DG

National Conference on Recent Advances in Agrobiotechnology for Sustainable Agricultural Practices, Moolji Jaitha College, Jalgaon, 5-6 February 2012

National Conference on Emerging Trends in Biotechnology, School of Life Sciences, North Maharashtra University, Jalgaon, January 2012

Oak MD

99th Indian Science Congress, Bhubaneswar, 3-7 February 2012

Seminar on wheat milling and end use quality evaluations, New Delhi, 15 November 2011

Paranjape AR

XXIII Indian Colloquium on Micropaleontology and Stratigraphy and International Symposium on Global Bioevents in the Earth History, Bengaluru, 9-11 December 2011

Patil RM

Bharat Utsav 2011 Science, Hyderabad, 18-22 August 2011

Rajput B and Kshirsagar P

International Conference of XXI Indian Association for Angiosperm Taxonomy and National Seminar on Biodiversity Conservation and Climate Change, Institute of Minerals and Materials Technology, Bhubaneswar, Odisha, 2-4 December 2012

Singh PN

99th Indian Science Congress, Bhubaneswar, 3-7 January 2012

Singh SK, Sharma R, Mukherjee G, Kumar P

Workshop, Next Two Decades of Chemical Sciences & Technology, Pune 23 September 2011

Taware SP and Varghese P

41st Annual Group Meeting of Soybean workers, Bengaluru, 26-28 April 2011

Taware SP, Varghese P and Jaybhay SA

42nd Annual Group Meeting of Soybean workers, Palampur, 22-24 March 2012.

Tetali S

20th Group Workers' Meeting, Periyakulam, Thenni, 29 September-2 October 2011

Vaidya HS

National Conference on Biodiversity Assessment, Conservation and Utilization, Abasaheb Garware College, Pune, 9-11 February 2012

Varghese P

National Seminar on New Frontiers in Plant Science Research for Sustainable Development, Khordha, 25-26 February 2012

Invited Talks by ARI Scientists

Datar MN

Pune, January 2012

Dhakephalkar PK

- Pune, September 2011
- New Delhi, August 2011
- Perth, Australia, September 2011
- Aurangabad, February 2012
- Pune, February 2012

Ghaskadbi S

- Iran, May 2011
- Nasik, October 2011
- Chennai, November 2011
- Aurangabad, January 2012
- Ahmednagar, March 2012
- Pune, September 2011
- Baramati, October 2011
- Bhubaneswar, January 2012
- Kishangarh, February 2012
- Pune, March 2012
- Bangalore, October 2011
- Pune, October 2011
- Pune, January 2012
- Jaipur, February 2012

Ghate VS

Pune, September 2011

Joshi BN

Pune, April 2011

Kanekar PP

- Pune, January 2012
- Kolhapur, February 2012
- Pune, 2012
- Kottayam, Kerala, March-April 2012

Kulkarni KG

Pune, January 2012

Kulkarni PP

Kobe, Japan, September 2011

Kumaran KPN

Lucknow, August 2011

Mukherjee G

Jalgaon, February 2012

Naik DG

- Pune, April 2011
- Nanded, December 2011
- March 2012
- Pune, November 2011
- Jalgaon, January 2012
- Pune, November 2011
- Pune, February 2012

Panchang R

Pune, February 2012

Paknikar KM

- Patna, April 2011
- Wardha, January 2012
- Pune, March 2012
- Jalna, September, 2011
- Wardha, January 2012
- Mumbai, March 2012
- Chennai, October 2011
- Loni, February, 2012

Rajesh Kumar KC

Peechi, November 2011

Ranade DR

- Mumbai, August 2011
- New Delhi, October 2011
- Pune, February 2012
- New Delhi, August 2011
- Navi Mumbai, February 2012

Ratnaparkhi A

Jaipur, February 2012

Singh SK

- Amravati, February 2012
- Nagpur, March 2012
- Mumbai, May 2011
- Chennai, March 2012
- Kolhapur, February 2012

Deputations Abroad

Misra SC

Indo-Australia ACIAR project, CSIRO, Canberra, 28 November - 5 December 2011

Visits Abroad

Agrawal S, Bodas D

37th International Conference on Micro & Nano Engineering, Berlin, Germany, September, 2011

Apte PP

The International Conference on Nutrition and Growth, France 1-3 March 2012

Chitte RR

I Biotechnology World Congress, Sharja, UAE, February 2012

Dhakephalkar PK

Rhizosphere III, Perth, Australia, September 2011

Ghaskadbi S

1st International Congress, Cellular and molecular advances in non-contagious diseases, Iran, May 2011

Kulkarni KG

World conference on Paleontology and Stratigraphy, Thailand, 28 November-2 December 2011

Kulkarni PP

V International Conference in Metals and Genetics, Japan, 4-9 September 2011

Limaye RB

XVIII INQUA Congress Conference, Switzerland, 21-27 July 2011

HRD activities

Guidance and training was given to MSc, MTech students of different colleges.

Deputation for Training/ Study

Gite SS

International Course in Nutrition Research Methods, Bangalore, 9-20 January 2012

Gokhale MK

Data Dissemination Workshop, Directorate of Census Operations, Gokhale Institute, Pune, 29 March 2012

Joshi BN

Workshop, Indo-German collaborative initiatives in research in Life Science, IISER Pune, 24 February 2012

Rajwade JM

Project Development Workshop, National Academy of Agricultural Research Management, Hyderabad, February 2012

Appointment on Academic and Professional Bodies

Behera BC

Regional Editor, Asian journal of Plant Sciences
Technical Editor, Asian journal of Biotechnology
Regional Editor, Asian journal of Biological Sciences
Technical Editor, International Journal of Biological Chemistry
Regional Editor, Research Journal of Phytochemistry
Editorial Board Member, Microbiology Insights
Editorial Board Member, Integrative medicine Insights
Editorial Board Member, Boletin Latioamericano y del Caribe de Plantas Medicinales y Aromaticas
Editorial Board Member, International Journal of Food, Agriculture & Environment
Editorial Board Member, Journal of Biomedical Research
Editorial Board Member, The Internet journal of Microbiology
Editorial Advisory Board Member, African Journal of Biomedical Research
Editorial Board Member, African Journal of Environmental Science & Technology
Editorial Board Member, Plant Molecular Biology and Biotechnology
Scientific Board Member, Technologia Alimentaria Series
Editorial Reviewer, Fungi

Dhakephalkar PK

Member of Research and Recognition (RR Committee) Committee, North Maharashtra University, Jalgaon
Institutional Biosafety Committee, ARI, Pune
Institutional Biosafety Committee, National Toxicology Centre, Pune, DBT Nominee
Institutional Biosafety Committee, KDL Ltd., Khopoli, DBT Nominee
Institutional Biosafety Committee, Raj Biotech, Pune
Central Public Information Officer, ARI, Pune

Ghate VS

Vice-President - Outstation, Society of Ethnobotanists, May 2010-May 2013
Member, Advisory Committee, Smritivan and Smritiudyan projects, Nisarga-sevak, Pune
Member, Board of Studies - Botany, University of Mumbai

Ghate VS, Gokhale MK, Naik DG

Expert, Women Scientist Fellowship Programme (WOS-B), Agharkar Research Institute, Pune

Joshi BN

Referee, Evidence based complementary and alternative medicine; Chinease Integrative medicine; Pakistan Journal of Scientific and Industrial Research; AJAR; Philippine Journal of Science; International Journal of Diabetes in developing countries

Kanekar PP

Women Bioscientist Award 2011, Society for Applied Biotechnology

Honorary Fellow of Society for Applied Biotechnology

Nominated as a member of Project Evaluation Group under State Science and Technology Programme (SSTP) of Technology Development and Transfer (TDT), DST, Govt. of India, for the period 2010-2012

Member, Project evaluation group, State Science and Technology Programme (SSTP) of TDT, DST, Govt. of India, for the period 2010-2012

Kulkarni PP

Referee: Journal of Agriculture and Food Science

Mukherjee G

Associate Editor, African Journal of Food Science & Technology

Editorial Board member, International Journal of Life Science & Medical Research

Reviewer, Current Microbiology, Springer, New York

Reviewer, International Research Journal of Microbiology

Reviewer, African Journal of Food Science & Technology

Reviewer, African Journal of Biotechnology

Reviewer, British Microbiology Research Journal

Chairman, Technical session II, National Conference on Recent Advances in Agrobiotechnology for Sustainable Agricultural Practices (RAAB-2012). MJ College, Jalgaon, February 2012

Judge, Oral and Poster presentation, National Conference on Recent Advances in Agrobiotechnology for Sustainable Agricultural Practices (RAAB-2012). MJ College, Jalgaon, 5-6 February 2012

Naik DG

DST Nominee, JRF selection, Botany Department, University of Pune, Pune

Referee, National conference on Innovative research and developments in Pharmaceutical sciences, Poona College of Pharmacy, Pune

Expert, Panel Discussion Committee, Fergusson College, Pune

External Referee, Viva-voce examination, Department of Chemistry, University of Pune, Pune

Paknikar KM

Member, Academic Council, nominated by the Hon'ble Chancellor (Governor of Maharashtra), North Maharashtra University, Jalgaon: Member, 2010 onwards

Member, Board of Studies, M.Tech. Nanoscience and Nanotechnology, Pondicherry University, Puducherry, 2010-2012

Member, Research and Recognition Committee in Microbiology, University of Pune, Pune, 2011-2014

Member, Research and Recognition Committee in Biotechnology, Babasaheb Ambedkar Marathwada University, Aurangabad, 2011-2014

Member, Research and Recognition Committee in Microbiology, Swami Ramanand Tirth Marathwada University, Nanded, 2008-2011

Member, Board of Studies in Molecular Biology, Mumbai University, Mumbai, 2011-2014

Member, Programme Advisory Committee on 'Water Technology Initiative', Department of Science & Technology, Govt. of India, 2007-onwards

Expert Member, Technical Screening Committee, Small Business Innovation Research Initiative (SBIRI), Department of Biotechnology, Government of India 2010-2012

Member, Review Committee Research projects under different bilateral collaborations in the field of Agriculture and Environment Biotechnology, Department of Biotechnology, Government of India, 2010-2013

Member, National Advisory Committee, 8th BRSI Convention & International Conference on New Horizons in Biotechnology, National Institute for Interdisciplinary Science and Technology, Trivandrum, 2011

Invitee, India-UK Discussion meeting on Advanced Technologies for Water and Energy, Chennai 2011

Invited Member for Panel discussion, Indo-Finalnd workshop on 'Genomic Tools in Bioremediation", Nagpur, November 2011

Member, Board of Governors, Biotech Research Society of India, 2011-2013

Editor, Open Journal of Nanomedicine, Bentham, USA

Editor, World Journal of Pharmacology (Baishideng Publishing, China)

Editor, ISRN Nanotechnology (Hindawi Publishing Corporation, USA)

Patel P

Life Member, National Academy of Biological Sciences (NABS)

Reviewer, World Applied Science Journal; Journal of Science of Food and Agriculture; Journal of Agricultural Science and Technology; Journal of Pharmacognosy and Phytotherapy

Technical Editor, American Journal of Plant Physiology; Research Journal of Phytochemistry; Research Journal of Medicinal Plants; Research Journal of Seed Sciences; Trends in Horticultural Research

Ranade DR

Member, Board of Studies in Microbiology, University of Pune, 2011-2015

Subject Expert for book "Green Workshop" published by Tata Motors Ltd, Pune

Sarnaik SS

Invited as subject expert on the selection committee for the recruitment of Research Fellows at School of Life Sciences, North Maharashtra University, Jalgaon

Singh SK

Honorary Fellowship, Society of Applied Biotechnology (SAB)

Associate Editor, Journal of Basic and Applied Mycology, (SBAM), India

Reviewer, Chiang Mai Journal of Science, Thailand

Reviewer, Indian Phytopathology (IPS), ICAR, New Delhi

VCs nominee, Evaluation of PhD thesis, Goa University

Expert, *Viva-voce* examination, Goa University, Goa

Expert, Evaluation of project proposal submitted to DST for financial assistance

Member, National Advisory Committee of MSI Conference at Amravati

International Society for Fungal Conservation, UK

SK Singh (Member)

PN Singh (Member)

Rajesh Kumar KC, Convener, Indian chapter

Pramod Kumar (Member)

Honours and Awards

PhD degree award : University of Pune

Candidate	Title	Guide
Apte PP	Investigation on exercise regimes for reducing obesity among adolescent boys from urban affluent population in Pune	Rao S
Degaonkar A	Gluten protein analysis and molecular mapping of grain characteristics in tetraloid wheat	Rao VS
Deshpande M	Evaluation of Lactobacilli as a probiotic feed supplement to improve poultry health	Dhakephalkar PK
Jahagirdar SS	Curing of 'R'-Plasmids using compounds of natural origin - A novel approach to contain spread of antibiotic resistance	Dhakephalkar PK
Kamble PB	Ethno-medico-botanical studies on Bhor Taluka, Pune District	Kulkarni DK
Kulkarni SO	Production of biodegradable polymer by extremophilic bacteria isolated from Lonar lake	Kanekar PP
Misar AV	Bioprospective studies of some Indigenous plant resources for their hepatoprotective and antidiarrhoeal activity	Mujumdar AM
Mishra P	Studies on chitinolytic fungi and their extracellular chitinase system Co-Guide	Singh SK
Nipunage DS	Studies on plant fossils from the Deccan Intertrappean Beds of Mandla District, M.P. and its correlation with Palaeoenvironment and Phytogeography	Bonde SD
Rajopadhye AR	Pharmacognostic Studies on Pittapapada Complex	Upadhye AS
Sonone A	Studies on antimicrobial, antioxidant, cardiovascular protective and antitumor activities of selected in vitro culture of lichens	Behera BC
Umrani Rinku	Studies on antidiabetic activity of zinc based sub-micronic preparations	Paknikar KM
Waingankar V	Studies on litter fungi from Western Ghats, India with special reference to some zygomycetes	Singh SK

Honours/ Awards/ Distinctions

Ghaskadbi S

Invited talk, Plenary session, Indian Science Congress, Bhubaneswar, January 2012

Member, Editorial Board, Indian Journal of Experimental Biology (2011-2013)

Member, Editorial Board, International Journal of Cellular and Molecular Medicine

Executive board member, Indian Society of Cell Biology (2011-2012)

Joint Secretary-cum-Treasurer, Moving Academy of Medicine and Biomedicine, Pune (2008-2014)

Member, Scientific Advisory Committee, Moving Academy of Medicine and Biomedicine, Pune

DBT Nominee, Institutional Bio-safety Committees of 1) National Center for Cell Science, Pune, 2) Lupin limited (Biotech Division), Pune and 3) InTox, Pune

Member, Central Management Council, Rajiv Gandhi Biotechnology Centre, R.T.M. University, Nagpur

Member, Advisory Committee for Teaching Program. Rajiv Gandhi Biotechnology Centre, R.T.M. University, Nagpur

Member, Research & Recognition Committee in Zoology, University of Pune

Honrao BK

Member, Zonal monitoring team for Peninsular Zone for monitoring of Coordinated wheat trials/ nurseries, 7-9 February 2012

Panchang R

DST Fellowship, Women Scientists Scheme (WOS-A)

Taware SP

Expert, Meeting on seed planning for *kharif* season of 2012-16 and rolling plan for seed production, Department of Agriculture, Pune, March 2012

Taware SP and Varghese P

Member, Soybean monitoring team, 19-25 September 2011

Varghese P

Member, Team to investigate problems of poor germination of soybean in Maharashtra, 22-24 August 2011

Expert, Soybean breeders meeting, Indore, 3 March 2012

Awards for Paper/ Poster Presentation

Best paper presentation award

Ginotra YP

Best Poster award, 'Structural and Biological properties of Cu-Abeta complex', XIV MTIC conference, Hyderabad, 10-13 December 2011

Gite SS

Best Presentation award, 'Impact of zinc supplementation on seroconversion to oral polio vaccine: A double blind randomized controlled trial (OPV-Z)', The International Course in Nutrition Research Methods, Bangalore, 9-20 January 2012

Vaidya HS

First prize, 'Pharmacologically active formulations from Indian propolis', National Conference on Biodiversity Assessment, Conservation and Utilization, Abasaheb Garware College, Pune, 9-11 February 2012

Engineer AS, Dhakephalkar AP & Dhakephalkar PK. (2012) Microbial route for the synthesis of optically pure unnatural amino acid of industrial importance National Conference on Birds eye view on Biotechnology and Bioscience, Aurangabad. Awarded first prize in poster session

Kulkarni SO, Kanekar PP, Jog JP, Patil PA, Nilegaonkar SS, Sarnaik SS, Kshirsagar PR (2011) Characterization of co-polymer poly (hydroxybutyrate-co-hydroxyvalerate) (PHB-co-PHU) produced by *Halomonas* campisalis MCMB-1027, its biodegradability and potential application, Bioresource Technology, 102(11):6625-6628, doi:10.1016/j.biortech.2011.03.054 (Impact Factor – 4.25) This paper received Prof. S. P. Agharkar Birth Centenary Gold Medal for the best paper published during the year 2011 by Ph.D. student Ms. SO Kulkarni, on 18th November 2011, the founder's day (Prof. S.P. Agharkar Memorial day)

Rao J, Shouche Y, Rastogi G, Bhardwaj A & Ranade D (2011). Sulphate reducing bacteria isolated from an oil field in India are most closely related to strains of Desulfovibrio from geographically remote oil field. 3rd International Symposium Applied Microbiology and Molecular Biology in Oil Systems. 13-15 June 2011, Canada

Thombre RS, Kanekar PP, Oak MD Application of cyclodextrin glycosyl transferase produced by *Exiguobacterium aurantiacum* MCM B-1021 as an antistaling enzyme in bread making. XXI Indian Convention of Food Scientists and Technologists (ICFOST) on "Innovations in Food Science and Technology to Fuel the Growth of the Indian Food Industry", Pune, 20-21 January 2012, received first prize in poster session

Upasani G, Ravindran P, Valvhe R, Lanjekar V, Ranade D, Diwanay S (2012). Reduction of cholesterol by probiotics isolated from Indian traditionally fermented foods. International Conference on Business Opportunities in Life Sciences on 28th to 30th January 2012.

Supervision of Postgraduate Students

(Guide, Co-guide, Student, Topic)

Bonde SD

Gamre PG: Palaeofloristic diversity of the Deccan Intertrappean Beds of Wardha District, Maharashtra, India and its environmental significance

Chiplonkar SA

Kadam N: Studies in nutritional aspects of bone health in premenarchal girls and postmenopausal women

Pandit D: Studies in relationship of nutritional status with metabolic syndrome in children and risk of sub-clinical atherosclerosis

Dhakephalkar PK

Chitrakoti MR, Exploration of bacterial diversity from high temperature oil reservoirs for the degradation of hydrocarbons at elevated temperature. Co-guide: DR Ranade

Dahigaonkar KV, Exploration of bacterial diversity from high temperature oil reservoirs for the degradation of hydrocarbons at elevated temperature

Engineer AS, Exploration of subsurface microbial flora for the production of valuable enzymes.

Kanekar SP, Biodiversity and biotechnological exploration of halophiles from Andaman Islands and Lonar lake

Nema PS, Genetic and functional diversity of Plant growth promoting Acinetobacter from Wheat Rhizosphere.

Shete S, Production of cerium sulfide pigment using E. coli expressing recombinant dsr genes

Ghaskadbi SM

Barve A: Analysis of response of hydra to ultraviolet radiation

Ghodke K: Reactive oxygen species and chick embryonic development

Reddy PC: Insulin signaling in regeneration and pattern formation in hydra

Surekha KL: Role of growth factors in cell-cell signaling during angiogenesis

Ghate VS

Daptardar NS: Ecological assessment of selected virgin and degraded sacred groves from Taluka Deogad, Sindhudurg

Salunke RJ: Comparative pharmacognosy of medicinally important species of genus *Carissa* L.

Co-guide: Gunjkar G: Ethno-medico-Botanical study and quantitative assessment of commercially important medicinal plants from selected tribal areas of Thane district

Kanekar PP

Thombare RS: Studies on production of Cyclodextrin glycosyl transferase *CGTase) using alkaliphilic bacteria

Kanekar PP, Naik DG

Borgave S: Studies on production of antimicrobial compounds by alkaliphilic bacteria isolated from Lonar Lake

Kulkarni MS: Studies on production and characterization of antibiotic like compounds from thermophilic actinomycetes

Kanekar PP, Nilegaonkar SS

Jotshi J: Microbial production of collagenolytic protease and its application in recovery of value added products

Kanekar PP, Sarnaik SS

Patil VP: Microbial remediation of wastewater containing Nitroexplosive Diaminodinitroethylene (FOX-7)

Kulkarni DK

Patil PV: Studies on traditional agricultural practices and food grain management from Bhor (Pune District) and Mahad (Raigad District), Maharashtra State

Kasarkar AR: Ethnobotanical studies in family Zinziberaceae from South-Western Maharashtra with special reference to *Alpinia* and *Zingiber*

Kulkarni KG

Paranjape AR: Sequence stratigraphic studies of the Cretaceous succession, Cauvery basin, Ariyalur area, Tamil Nadu, India

Naik DG

Vaidya HS: Isolation and applications of bioactive natural products from Indian honeybee propolis

Waghole RJ: Exploration of *Tetrastigma sulcatum* for anti-fungal properties

Deshpande PV: Development of attractant/repellent formulations for Indian honeybees from *Swertia densifolia*

Paknikar KM

Agrawal S: Studies on phage based microfluidic assay for detection of food borne pathogens

Asani S: Mechanistic studies on anti-diabetic action of zinc oxide nanoparticles *in vivo*

Bhagat P: Nuclear delivery of SMAR-I using nanoparticles to modulate cancer

Deshmukh S: Studies on catalytically inactivated enzymes as molecular recognition elements and their possible applications

Haghniaz R: Radiofrequency induced hyperthermia using dextran coated Lanthanum Strontium Manganese Oxide for tumor regression in mice

Kulkarni V: Studies on magnetic fluid hyperthermia and chemotherapy for treatment of breast cancer

Ranade DR

Gophane RR: Bioconversion of starch industry waste to n-butanol

Kamalaskar LB: Investigation of a novel anaerobic strain DMHC-10 for polyphasic identification and biohydrogen production. (Co-guide: Dr P K Dhakephalkar)

Lanjekar VB: Isolation, identification and functional characterization of obligate anaerobic bacteria from human gastro-intestinal tract. (Co-guide: Dr Yogesh Shouche, NCCS, Pune)

Nerlekar MR: Diversity of methanogens from oil reservoir in India. (Co-guide: Dr P K Dhakephalkar)

Singh KG: Studies on anaerobic bacteria producing butyric acid and butanol from distillery waste

Rao S

Parab P: Assessment of abdominal obesity for screening NCD risks among affluent adults from India- Pre-synopsis seminar given

Raje S: Statistical model for early prediction of risk of low birth weight in rural Indian women

Ranade P: Investigating docosahexaenoic acid status in relation to prematurity and cognition

Rao A: Investigations on calcium during pregnancy with size at birth & metabolic risk in offsprings of wistar rats

Tamhankar SA

Cruze Lilly: Molecular analysis for leaf rust resistance in bread and durum wheat

More Manjusha: Molecular characterization of grape and its wild relatives

Tamhankar SA and Rao VS

Dangi Rakhee: Diversity in *Trigonella*: Molecular and chemical characterization

Upadhye AS

Kumbhalkar BB: Pharmacognostic and molecular studies of some medicinal plants from family Cucurbitaceae

Seminars/ Workshops/ Training Courses Organized

National Technology Day, 11 May 2011

IPR mediated technology development and management
Dr Siddharth Jabade
Co-ordinator, IPR Facilitation Centre
Vishwakarma Institute of Technology, Pune

Hindi Day, 13 September 2011

Dr Omkarnath Shukla
Hindi Officer,
Indian Institute of Tropical Meteorology
Pune

Vigilance Awareness Programme

31 October - 5 November 2011

Utility of RTI in vigilance

Shri Sharad Borde

Retd. IAS Officer and Visiting Faculty, YASHADA, Pune

3 November 2011

Shri GB Joshi Memorial Lecture

16 November 2011

Taming of abiotic stresses under impinging climate change

Dr KPR Vittal

Director, National Institute of Abiotic Stress Management (NIAM), Malegaon

Baramati, Pune

Dr GB Deodikar Memorial Lecture

17 November 2011

Endangered Earth

Prof. SF Patil

Former Vice-Chancellor

Bharati Vidyapeeth University, Pune

Prof. SP Agharkar Memorial Lecture

18 November 2011

Chemistry towards materials of future

Dr. Sourav Pal

Director, National Chemical Laboratory

Pashan, Pune

Prof. SP Agharkar Birth Centenary Gold Medal

for the best research paper published in 2010-11 based on PhD work

Dr Snehal O Kulkarni

Shetkari Mela (Farmer's meet)

31 January 2012 and 10 February 2012

Around 250 farmers visited Hol farm and information about new wheat, soybean and grape varieties was provided. An interaction was held regarding cultivation practices. Dr SP Taware and Dr BK Honrao spoke on crop research at ARI, Pune. ARI and Krishi Vidnyan Kendra, Baramati jointly organized the *mela*.

WOS-B

Screening Committee Meeting, ARI, Pune, 1 June 2011
Selection Committee Meeting, New Delhi, 20-22 July 2011;

Selection Committee meeting and Group Monitoring Committee meeting of WOS-B, Kolkata, 28 August 2011; New Delhi, 20-21 September 2011; Pune, 27-28 September 2011; Bengaluru, 23-24 November 2011

Coordination: Naik DG and Gokhale MK

National Science Day, 23-28 February 2012

The emerging green economy: Contexts and contours

Shri GM Pillai
Director General
World Institute of Sustainable Energy, Pune
23 February 2012

Bio-energy in India: An overview

Dr AK Dhussa
Director, Ministry of New and Renewable Energy
New Delhi
24 February 2012

Preparing for our secure energy future

Dr Anil Kakodkar
DAE Homi Bhabha Chair
BARC, Mumbai
27 February 2012

Energy, environment and nanoscience: 'Small' solutions to big problems

Dr Satishchandra Ogale
Scientist, Physical and Materials Chemistry
National Chemical Laboratory, Pune
28 February 2012

4th monitoring meeting of DST
5 March 2012

National Facility for Culture Collection of Fungi
Coordination: Singh SK

Exhibition of Fossils and Minerals, 21-22 March 2012

The exhibition received a stupendous response from students and people recording a phenomenal foot fall of over 15,000.

Lecture, 28 March 2012

Redefining the groundwater problematique in India: bridging the science and development divide

Dr Himanshu Kulkarni
Executive Director, ACWADAM, Pune

Popularization of Science and Society Oriented Activities

Ghate VS

Organization of two Participatory Rural Appraisal workshops for forest officers. Nasik, 13 May 2011; Ahmednagar, 17 May 2011.

Coordination of courses: Twelve weeks Certificate course in Field Botany- in collaboration with Nisargasevak, March - May 2011; Six months Certificate Course in Home Gardening, MACS, July 2011 to January 2012

WOS-B programme publicity on AIR, Pune; Presentations on WOS-B programme at Tilak Ayurved Mahavidyalay; Abasaheb Garware College; Vanaspati Parichay Pramanpatra Course, ARI, Pune.

Popular Articles

Datar MN. Weekly column related to plants, Daily Sakal

Karkamkar S, Tetali S and Misra SC. 2011. Draksha – rasatil upayogi pre-biotics. Drakshvrutta Smaranika, 51(9):82 *(Marathi)*

Misra SC, Honrao BK, Chavan AM, Surve VD, Khade VM and Patil RM. 2011. MACS 6222: A new high yielding wheat variety. Baliraja, 11:19 *(Marathi)*

Patil RM, Annapurna B, Oak MD, Honrao BK, Khade VM, Chavan AM, Surve VD, Bagwan J, Bankar DN, Katore T and Misra SC. 2011. Impact of climate change on production, quality and disease resistance in Wheat. Genhu Evam Jau Swarnima, 3: 46-51 *(Hindi)*

Institutional Research Projects

Division of Microbial Sciences

Project Code	Project Title	Investigator(s)	Associated staff and students
MIC-10	Microbial diversity and Conservation DR Ranade	PP Kanekar DC Kshirsagar KM Paknikar PK Dhakephalkar SS Sarnaik RR Chitte	AS Kelkar A Engineer SB Borgave
MIC-24	Pharmacological aspects of fibrinolytic enzyme Actinokinase from thermophilic Streptomyces sp.	RR Chitte PP Kanekar	GA Kulkarni
MIC-26	Biological Hydrogen Production	DR Ranade	L Kamalskar
MIC-27	Production of enzyme collagenase	PP Kanekar SS Nilegaonkar	J Jotshi
MIC-28	Isolation and characterization of obligate anaerobic bacteria from human gastrointestinal tract	DR Ranade	VB Lanjekar
MIC-29	Production of Cerium Sulphide pigment through microbial route	PK Dhakephalkar PP Kanekar DR Ranade	
MIC-30	Exploration of thermophiles for industrially important biomolecules and enzymes	PK Dhakephalkar DR Ranade	Pore Soham Pendse Nachiket

Division of Plant Sciences

Project Code	Project Title	Investigator(s)	Associated staff and students
Botany Group			
BOT-15	Digitizing AHMA	Ghate VS Datar MN	Shevte N
BOT-16	Seed and seedling studies on high valued medicinal plants of Maharashtra	Ghate VS Patel PP	Shevte N Kshirsagar P
BOT-17	Repository of Crude drugs and Authentication service	Upadhye AS	Kumbhalkar B
BOT 18	Plant Community Studies on Selected Grasslands of Maharashtra	Ghate VS Datar MN	-
BOT 19	Development of HPTLC profile library of PRS (Phytochemical Reference Standard)	Upadhye AS	-
BOT 20	Evaluation of antioxidant potential from plant resources: Fruit and vegetable juices	Upadhye AS Patel PP	Misar A
BOT 21	Usage of suitable substitutes in herbal drugs	Patel PP	-
Genetics and Plant Breeding			
GEN 04	Tagging of some important disease resistance and quality traits in wheat	Misra SC Tamhankar SA Oak MD	Deshpande A Jadhav K Gole C
GEN 12	In vitro techniques for conservation and multiplication of economically important plants and crop plants	Misra SC Mukherjee P	Bachute S
Mycology and Plant Pathology			
MYC-01	Studies of lichenized fungi including culture *in vitro* and bioactive metabolites	BC Behera BO Sharma	Morey MV Verma N
MYC-03	Studies on forest fungi	SK Singh	Gaikwad SB Sutar SA
MYC-06	To isolate endophytic fungi from medicinal plants and their metabolites	SK Singh	Pawle G
ARI/ SP/160	National Facility for Culture Collection of Fungi (03.03.2008 to 02.03.2013) & Fungal Identification Service (MYC02)	SK Singh	Singh PN Sharma BO Sharma R Senthilarasu G Mukherjee G Rajesh Kumar KC Pramod Kumar Swami SV Waingankar VM Kajale S

Division of Animal Sciences

Project Code	Project Title	Investigator(s)	Associated staff and students
Biometry and Nutrition Group			
New BIO-1	Role of maternal dietary calcium in relation to non-communicable diseases (NCDs) risks in adult offspring	Gokhale MK Joshi BN Kulakarni PP	Sarode JS Apte PP Rao A
New BIO-2	Hepcidin-a Possible Indicator for assessing iron status	Kulakarni PP Joshi BN Gokhale MK	Apte PP Laxmi V
New BIO-4	Functional foods for Diabetes: Evaluation of oral hypoglycemic proteins from *Costus speciosus* (Koenig), Insulin plant Pushkarmula) from Western Ghats of India	Joshi BN	Hardikar M
Chemistry Group			
CHM 1	Study of Pheromones & Semiochemicals	Naik DG	CN Dandge Puntambekar HM Deshpande P Rupnar S
CHM 3	Chemical investigations of medicinal plants	Naik DG Mujumdar AM Srivastava P	RJ Waghole HS Vaidya DK Kulkarni
CHM 7	Chemical examination of honeybee propolis & study of its applications	Naik DG Puntambekar HM	HS Vaidya
CHM 9	Environment-friendly synthesis of biomolecules	Srivastava P Waghole RJ	–
Geology and Paleontology Group			
GEO-17	Ichnofauna and Palaeoenvironment of Jaisalmer formation (Bathonian - callovian), Rajasthan	Kulkarni KG	Gurav S
Zoology Group			
ZOO-8	Search for homologues of vertebrate development specific genes in hydra	Ghaskadbi SM Patwardhan VG	Barve A
ZOO-12	Use of differential proteomics to understand regeneration, pattern formation and stem cell biology in hydra	Ghaskadbi SM Patwardhan V	Deoli V
ZOO-14	In- Vivo binding assay as a tool to study neuronal development	Ratnaparkhi A	

DST National Facility

National Fungal Culture Collection of India (NFCCI-WDCM 932)

Partial List of Beneficiaries

Sl No.	Name of Organization/Institute and Place
1.	Acharya N.G. Ranga Agricultural University, Hyderabad, Andhra Pradesh
2.	Centre of Advanced Studies in Marine Biology, Cuddalore, Tamil Nadu
3.	CSK Himachal Pradesh Krishi Vishvavidyalaya, Kangra, Himachal Pradesh
4.	Dr. Hari Singh Gour Vishwavidyalaya, Sagar, Madhya Pradesh
5.	Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra
6.	Guru Nanak Dev University, Amritsar, Punjab
7.	Jadhavpur University, Kolkata, West Bengal
8.	Junagadh Agricultural University, Junagarh, Gujrat
9.	Lucknow University, Lucknow, Uttar Pradesh
10.	Madurai Kamraj University, Madurai, Tamil Nadu
11.	Manipal College of Pharmaceutical Sciences, Manipal, Karnataka
12.	Mohanlal Sukhadia University, Udaipur, Rajasthan
13.	North- Eastern Hill University, Shilong, Meghalaya
14.	Pt. Ravishankar Shukla University, Raipur, Chhattisgarh
15.	The Maharaja Sayajirao University of Baroda, Vadodara, Gujrat
16.	University of Delhi (South Campus), New Delhi
17.	University of Jammu, Jammu, Jammu & Kashmir
18.	Directorate of Plant Protection, Quarantine & Storage, Chennai, Tamil Nadu
19.	Directorate of Rapeseed Mustard Research (ICAR), Bharatpur, Rajasthan
20.	Indian Institute of Technology (IIT), Roorkee, Uttar Pradesh
21.	Institute of Microbial Technology-MTCC (CSIR), Chandigarh, Punjab
22.	GB Pant Institute of Himalayan Environment & Development, Almora, Uttarakhand
23.	National Centre for Cell Sciences (DBT), Pune, Maharashtra
24.	National Institute of Oceanography (CSIR), Panjim, Goa
25.	National Research Centre for Grapes (ICAR), Pune, Maharashtra
26.	National Research Centre for Pomegranate (ICAR), Solapur, Maharashtra
27.	Regional Plant Resource Centre (Govt. of Orrissa), Bhubaneswar, Orissa
28.	Tropical Botanical Garden & Research Institute, Thiruvanthapuram, Kerala
29.	Vasant Dada Sugar Institute (VSI), Pune Maharashtra
30.	Vellore Institute of Technology University, Vellore, Tamil Nadu
31.	Vivekanand Institute of Tropical Mycology, Chennai,Tamil Nadu
	Industries/Private Centers
1	M/s Aamby Valley Ltd. Lonavala, Maharashtra
2	M/s Agriland Biotech Ltd., Baroda, Gujrat
3	M/s Ambika Biotech & Agro Services, Mandsaur, MP
4	M/s Cadila Pharmaceuticals Ltd. Ahmadabad, Gujrat
5	M/s DSCIGN Biosys (P) Ltd., Banglore, Karnataka
6	M/s EI Dupont India Pvt. Ltd., Pune, Maharashtra
7	M/s IPCA Laboratories Ltd., Dadra & Nagar Haveli, Gujrat
8	M/s K. F. Bioplants Pvt. Ltd., Pune, Maharashtra
9	M/s Leeds Kem Agro (India) Ltd., Jalgaon, Maharashtra
11	M/s Syngenta India Ltd., Pune, Maharashtra
12	M/s Tokita Seed India (P) Ltd., Banglore, Karnataka

Personnel (List of Staff Members as of 31/03/2012)

Officiating Director
Dr. D.R. Ranade (Sc.F)

Animal Sciences Division
Dr S.M. Ghaskadbi, Sc.F & Head

Biometry & Nutrition Group
Dr (Ms) M.K. Gokhale, Sc.D
Dr.(Ms) B.N. Joshi, Sc.D
Dr. P.P. Kulkarni, Sc.C
Ms. J.S. Sarode, Lab Asst. B
Ms. P.P. Apte, Lab Asst. A
Ms. A Kochitty, PS

Chemistry Group
Dr. D.G. Naik, Sc.F, In-Charge
Dr. (Ms.) P. Srivastava, Sc.B
Dr. (Ms) C.N. Dandge, Tech. Officer B
Dr. (Ms) H.M. Puntambekar, Tech. Officer B
Shri R.J. Waghole, Technical Asst. A
Ms. R.B. Bharmal, Tech. Asst. A

Geology & Palaeontology Group
Dr. (Ms) KG Kulkarni, Sc.C
Shri C.M. Awere, Tech. Officer A
Shri. P.G.Gamre, Tech. Asst. B
Shri S.S. Deshmukh, Lab. Asst. D
Shri N.S. Mane, Lab Attd. C

Zoology Group
Dr. S.M. Ghaskadbi, Sc.F, I-Charge, Zoology & SEM Facility
Dr. (Ms) V.G. Patwardhan, Sc.E
Dr. Mrs. A. Ratnaparkhi, Sc.D
Shri M.B. Daware, Tech. Officer A
Shri V.B. Sindol, Tech. Asst. B
Mrs. R.B. Londhe, Tech. Asst. A

Microbial Sciences Division
Dr. K.M. Paknikar, Sc. F, Head
Dr. P.K. Dhakephalkar, Sc.E
Dr. (Ms) S.S. Nilegaonkar, Sc.D
Dr. (Ms) S.S. Sarnaik, Sc.D
Dr. R.R. Chitte, Sc.C
Mr. P.R. Kshirsagar, Sc.B
Dr. (Ms) D.C. Kshirsagar, Tech. Officer B
Ms. A.S. Kelkar, Tech. Officer A
Shri. V.K. Nalavade, Lab Asst .D
Shri. V.M. Lanjekar, Lab Asst. B
Ms JV Deshpande, Steno Gr. II
Shri G.M. Ingale, Lab Attd. C
Shri S.M. More, Lab Attd. C

Botany Group
Dr. (Ms) A.S. Upadhye, Sc.B
Dr. M.N. Datar, Sc.B
Dr. P.R. Patel, Sc.B
Shri V.N. Joshi, Tech. Asst. B
Dr. Mrs. A.S. Misar, Tech. Asst. A
Shri M.H. Mhetre, Lab Asst. C
Mrs. N.S. Gaikwad, Lab Asst. A
Shri M.D. Chavan, Lab Attd. D
Shri S.N. Gajbhar, Lab Attd. DMycology & Plant Pathology Group

Nanobioscience Centre
Dr. K.M. Paknikar, Sc.F, In-Charge
Dr. (Ms) JM Rajwade, Sc.C
Dr. D.S. Bodas, Sc.C
Dr. Vandana Ghormade, Sc. C
Shri SS Waghmare, Lab Asst. B
Ms. SS Kalekar, Asst. A

Virology
Ms. R.B. Sawant, Tech. Asst. A

Botany Group
Dr. (Ms) A.S. Upadhye, Sc.B
Dr. M.N. Datar, Sc.B
Dr. P.R. Patel, Sc.B
Shri V.N. Joshi, Tech. Asst. B
Dr. Mrs. A.S. Misar, Tech. Asst. A
Shri M.H. Mhetre, Lab Asst. C
Mrs. N.S. Gaikwad, Lab Asst. A
Shri M.D. Chavan, Lab Attd. D
Shri S.N. Gajbhar, Lab Attd. D

Mycology & Plant Pathology Group

Dr. S.K. Singh, Sc.D
Dr B.C. Behera, Sc.D
Dr. P.N. Singh, Sc.B
Dr. (Ms) B.O. Sharma, Sc. B
Dr. Rahul Sharma, Sc.B
Dr. G. Senthilarasu, Sc.B
Dr. Gunjan Mukharjee
Dr. K.C. Rajesh Kumar, Sc.B
Mr. Pramod Kumar, Sc.B
Shri B.R. Kakade, Tech. Officer A
Mr. S.B.Gaikwad, Tech. Asst. A
Shri S. Swami, Tech. Asst. A
Mrs. V.M. Waingankar, Tech. Asst. A
Shri K.D. Gole, Lab Asst. B

Genetics & Plant Breeding Group

Dr. S.C. Misra, Sc.E, In-Charge
Dr. S.P. Taware, Sc.E
Dr. (Ms) S.A. Tamhankar, Sc.E
Dr. B.K. Honrao, Sc.D
Dr. Mrs. S.P. Tetali, Sc.C
Dr. P. Varghese, Sc.B
Dr. M.D. Oak, Sc.B
Mr. S.A. Jaybhay, Sc.B
Shri A.M. Chavan, Tech. Officer A
Shri V.M. Khade, Tech. Officer A
Shri V.D. Surve, Tech. Officer A
Dr. R.M. Patil, Tech. Asst. B
Ms. S.P. Karkamkar, Tech. Asst. B
Mr. J.H. Bagwan, Tech. Asst. B
Mrs. A.L. Bipinraj, Tech. Asst. B
Shri B.D. Idhol, Tech. Asst. B
Shri B.N. Waghmare, Tech. Asst. A
Mrs. A.A. Deshpande, Tech. Asst. A
Shri. D.H. Salunkhe, Lab Asst. A
Shri D.N. Bankar, Lab Asst. A
Shri P.G. Lavand, Lab Asst. A
Shri A.D. Sonvalkar, Driver
Shri L.S. Chavan, Lab Attd. E
Shri S.S. Khomane, Lab Attd. E
Shri M.T. Gurav, Lab Attd. Ci
Shri T.A. Kolte, Lab Attd. C
Shri R.D. Shinde, Lab Attd. C
Shri S.L. Bhandalkar, Lab Attd. B
Shri S.R. Kachhi, Lab Attd. B
Shri S.V. Ghadge, Lab Attd. A
Shri D.L. Kolte, Lab Attd. A

Administration

Shri G Barik, A.O.
Shri P.S Pujari, Officer A
Ms V.V. Dunakhe, Asst. C
Shri A.D. Joshi, Asst. B
Shri CD Nagpure, Asst. A
Ms M.B. Tiwari, Asst. A
Ms. M.M. Kopargaonkar, Asst. A
Shri R.M. Salunke, Attendant C
Shri B.B Gavali, Driver
Shri R.B. Kale, Driver
Shri R.M. Dhandhore, Attendant C
Shri K.R .Sathe, Attendant A
Shri S.P. Balsane, Attd. A

Accounts

Sqn Ldr S Francis (Retd), Fin & A/c. Officer
Shri S.K. Walambe, Section Officer
Ms. P.P. Pathak, Asst. C
Ms. S.A. Bibikar, Asst. C
Ms. S.A. Tembe, Asst. C
Shri S.V .Kulkarni, Asst. B
Ms. T.V. Kuhrade, Asst. A
Shri A.G Bhide, Attd. E

Purchase & Stores

Shri P.V. Gosavi, Officer C/ SPO
Shri P.C Bora, Officer
Shri H.N. Mate, Officer A
Shri A.G. Dhongade, Steno Gr.I
Ms. U.S. Kulkarni, Asst. B
Shri D.S. Zade, Assistant B
Ms. D.V. Gavade, Asst. A
Shri V.B. Bhalerao, Assistant C
Mrs. V.G. Tallu, Assistant C
Shri A.T. Salvi, Attd. C

Instrumentation Unit

Shri A.V. Chaudhari, Tech. Officer C
Ms. Manisha Khrade, Tech. Officer B
Shri B.N. Shinde, Technician D
Shri S.S. Kachi, Technician C
Shri S.B. Karanjekar, Attendant. D

Animal House (under Dr. S.M.G.)

Shri K.V. Tiwari, Attendant A
Shri V.M. Gosavi, Attendant A

Photography Unit (under I/C, Geology)

Shri BA Kawthekar, Technician D

Library

Dr. S.N Kulkarni, Sr.Lib. & Info. Officer
Shri R.P. Janrao, Sr. Lib. & Info. Assistant
Shri A.D. Patil, Asst. A
Shri R.R. Deshpande, Technician A
Shri R.R. Kale, Attendant B

Gardening Section (under I/C, Botany)

Shri L.M. Kale, Technician A

Other Technical Staff

Shri R.K. Dongre, Tech. Officer D
Dr. G.K. Wagh, Tech. Officer D
Shri A.S. Waghole, Technician D

Appointments

Ms. M.M. Kopargaonkar, Asst. A – 05.04.2011
Mr. P.V. Gosavi, Officer 'C'/ SPO – 02.06.2011
Mr. S.A. Jybhay, Jr. Agronomist (Sc.B), 17.11.2011

Superannuation

Dr. P.P. Kanekar, Sc. G (after extension of one year) 30.06.2011
Dr. K.P.N. Kumaran, Sc. F – 31.03.2011 (A.N.)
Dr. V.S. Ghate, Sc. E – 30.11.2011
Mr. S.T. Girgosavi, Lab Asst. D – 31.05.2011
Smt. P.R. Gandhi, Officer B – 30.09.2011
Mrs. B.A. Majgaonkar, Officer A – 30.04.2011
Mr. N.K. Kunsavlikar, Assistant C – 31.08.2011
Mr. A.S. Kulkarni, Assistant A – 30.09.2011
Mr. N.C. Kumbhar, Driver – 31.05.2011

Voluntary Retirement

Dr. A.N. Kanade, Sc. E – 06.05.2011
Mrs. S.S. Phulambrikar, Asst. LIO –

Resignation

Dr. B. Sen, Sc. C – 21.11.2011
Dr. Sonia Kale, Sc. B – 30.11.2011
Dr. P.K. Das, Sc. B – 23.12.2012
Mr. A.S. Rasherao, Tech. Asst. A – 11.02.2011
Mr. R.V. Kadu, STA (TAA) – 28.11.2011

Death

Mr. B.D. Kshirsagar – Attd. D

Reservation & Concessions

To provide adequate representation of SCs, STs and OBCs in direct recruitment posts instructions given by the Govt. of India, Dept. of Per. & Trg. OM NO.36012/2/96-Estt. (Res.), dated 2 July 1997 have been implemented.

Details of posts filled during 2011-2012

Group	SC	ST	OBC	General	Total
A	-	-	1	1	2
B	—	—	—	-	-
C	-	-	-	1	1
Total	-	-	1	2	3

Status of Official Language

Hindi compliance

In Pursuance of the Govt. of India's official Language Policy, following steps were taken to promote the usage of Hindi in official work:1) Every year Annual Report is printed in Hindi, 2) To encourage the use of Hindi a number of bilingual letters are issued to Group 'D' employees (Memos, Reminders, Memorandum, Notices, etc., 3) Scientists are using Hindi in their written communication, 4) More preference is given to promote the usage of Hindi in official work, 5) During the year we continued to display 'Aaj Ka Shabda' on the board fixed in the main building of the Institute for the purpose of promoting official language in daily use.

Auditor's Report 2011-12

Auditor's Report 2011-12

Agharkar Research Institute of Maharashtra Association for the Cultivation of Science, Pune
Aided By Department of Science and Technology, Government of India, New Delhi

AUDITOR'S REPORT

We have audited the attached Balance Sheet of Agharkar Research Institute of Maharashtra Association for the Cultivation of Science, Pune as at 31st March, 2012 and the Income and Expenditure Account for the year ended on that date, annexed there to.

These financial statements are responsibility of the Institute's Management. Our responsibility is to express opinion on these financial statements based on our Audit.

We conducted our Audit in accordance with the auditing standards generally accepted in India and provisions of Bombay Public Trust Act, 1950 (Wherever necessary). Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from any material misstatement. An audit includes examining evidence supporting and disclosures in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by Management, as well as evaluating the overall financial statement presentation and reporting. We believe that our audit provides a reasonable basis for our opinion.

Closing stock as on 31st March, 2012 has been included in the financial statements as valued and certified by the management of the Institute. Valuation has not been verified by us and reliance has been placed on the value of closing stock certified by the management.

Subject to above, we report that:

a. We have obtained all the information and explanations, which to the best of our knowledge and belief were necessary for the purposes of our Audit.

b. In our opinion, proper books of accounts as required by law have been kept by the institute so far as it appears from our examination of those books.

c. The Balance Sheet and Income and Expenditure account dealt with by this report are in agreement with the books of account.

d. In our opinion, the Balance Sheet and Income and Expenditure Account dealt with by this report, are in compliance with the accounting standards prescribed by the Institute of Chartered Accountants of India except the Accounting Standards-1 "Disclosure of Accounting Policies", Accounting Standards-2 "Valuation of Inventories", Accounting Standard 5 - "Net Profit or Loss for the Period, Prior Period items and changes in Accounting Policies", Accounting Standard 11- "The Effects of Changes in Foreign Exchange Rate", Accounting Standard 12- "Accounting for Government Grants". Exceptions can be referred to Significant Accounting Policies and Notes to Account followed by the Institute and impact of the same on Financial Statement cannot be quantified.

In our opinion and to the best of our knowledge and belief and according to the explanations given to us, the said accounts along with the notes there on give the information required by the law in the manner so required and reflect the true and fair view of state of affairs of the Institute.

a) In the case of Balance Sheet, of the state of affairs of the Institute as at 31st March, 2012

b) In the case of Income and Expenditure, of the surplus (Excess of Income over Expenditure) of the Institute for the year ended on that date.

For PATKI & SOMAN
Chartered Accountants

Place: Pune

Sd/-

Date: 21-09-2012

Partner

M.A.C.S's Agharkar Research Institute, Pune - 411 004

Balance Sheet as on 31.03.2012

Amount - Rs.

Particulars	Schedule	Current Year	Previous Year
CORPUS/CAPITAL FUND AND LIABILITIES:			
CORPUS/CAPITAL FUND	1	33,729,218	8,229,660
RESERVES AND SURPLUS	2	-	-
EARMARKED/ENDOWMENT FUNDS	3	33,374,691	22,834,550
SECURED LOANS AND BORROWINGS	4	-	-
UNSECURED LOANS AND BORROWINGS	5	-	-
DEFERRED CREDIT LIABILITIES	6	-	-
CURRENT LIABILITIES AND PROVISIONS	7	143,757,256	151,630,220
TOTAL		**210,861,165**	**182,694,430**
ASSETS:			
FIXED ASSETS	8	75,445,042	51,122,650
INVESTMENTS-FROM EARMARKED/ ENDOWMENT FUNDS	9	71,986,810	17,692,996
INVESTMENTS-OTHERS	10	-	-
CURRENT ASSETS,LOANS,ADVANCES ETC.	11	63,429,313	113,878,784
MISCELLANEOUS EXPENDITURES (to the extent not written off or adjusted)			
TOTAL		**210,861,165**	**182,694,430**
SIGNIFICANT ACCOUNTING POLICIES	24		
CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS	25		

The above Balance Sheet to the best of our knowledge & belief contains a True Account of the Funds and Liabilities of the Property and Assets of the Agharkar Research Institute.

Note : Previous year's figures are regrouped wherever necessary

As per our report of even date

For PATKI & SOMAN
Chartered Accountants

Sd/-
Sqn. Ldr. S. Francis (Retd)
Finance & Accounts Officer
ARI

Sd/-
D. R. Ranade
Officating Director
ARI

Sd/-
(S.M.PATKI)
Partner
21 Sept. 2012

M.A.C.S's Agharkar Research Institute, Pune - 411 004

Schedules forming part of Balance Sheet as at 31.03.2012

Schedule 1 : Corpus/Capital Fund

Amount - Rs.

Particulars	Current Year		Previous Year	
Balance as the beginning of the year	8,229,660		5,055,141	
Add : Contributions towards Corpus/ Capital Fund (Schedule D)	49,515,527		44,775,654	
Add/ (Deduct) : Balance of Net Income/ (Expenditure)	(24,015,969)		(41,601,135)	
		33,729,218		8,229,660
Balance at the end of the year		**33,729,218**		**8,229,660**

M.A.C.S's Agharkar Research Institute, Pune - 411 004

Schedules forming part of Balance Sheet as at 31.03.2012

Schedule 2 : Reserves & Surplus

Amount - Rs.

Particulars	Current Year		Previous Year	
1. Capital Reserve :				
As per last Account	0		0	
Addition during the year	0		0	
Less: Transfer to Establishment expenses	0	0	0	0
2. Revaluation Reserve :				
As per last Account	0		0	
Addition during the year	0		0	
Less: Deductions during the year	0	0	0	0
3. Special Reserve : A.R.I. Reserve Fund :				
As per last Account	0		0	
Addition during the year	0		0	
Add: Interest accrued	0		0	
Less: Deductions during the year	0	0	0	0
4. General Reserve :				
As per last Account	0		0	
Addition during the year	0		0	
Less: Deductions during the year	0	0	0	0
TOTAL	**0**	**0**	**0**	**0**

M.A.C.S's Agharkar Research Institute, Pune - 411 004

Schedules forming part of Balance Sheet as at 31.03.2012

Schedule 3 : Earmarked/Endowment Funds

Amount - Rs.

Particulars	Fund-wise Break Up				Totals	
	Tech.Dev. Fund	Dr. A. B. Joshi	Dr. A. D. Agate	Welfare fund	Current Year	Previous Year
a) **Opening balance of the funds**	22,136,351	571,942	4,334	121,923	22,834,550	19,421,865
b) **Additions to the funds:**			20,686	20,686		
i. Donations/grants						
ii. Income from investments made on account of funds.	1,632,235	10,000	351		1,642,586	1,105,295
iii. Amount received paid for 6th Pay Arrears	6,100,000				6,100,000	
iv. Overhead Charges from Scheme	2,804,180				2,804,180	2,552,590
v. Other Misc. Income	3,345				3,345	
Repayment of Advance from ARI	8,700,000				8,700,000	
TOTAL (a+b)	**41,376,111**	**581,942**	**4,685**	**142,609**	**42,105,347**	**23,079,750**
c) **Utilisation/Expenditure towards objectives of funds**		14,930			14,930	
i. Capital Expenditure						
Fixed Assets				-		
Others						
Advance paid to ARI	8,700,000				8,700,000	
ii. Revenue Expenditure						
Salaries, Wages and allowances etc.				-		
Rent						
Other Administrative Expense		500	15,226	15,726	245,200	
TOTAL (C)	**8,700,000**	**14,930**	**500**	**15,226**	**8,730,656**	**245,200**
NET BALANCE AS AT THE YEAR-END (a+b-c)	**32,676,111**	**567,012**	**4,185**	**127,383**	**33,374,691**	**22,834,550**

M.A.C.S's Agharkar Research Institute, Pune - 411 004
Schedules forming part of Balance Sheet as at 31.03.2012

Schedule 4 : Secured Loans and Borrowings

Amount - Rs.

Particulars	Current Year		Previous Year	
1. Central Government	0.00	0.00	0.00	0.00
2. State Government (Specify)	0.00	0.00	0.00	0.00
3. Financial Institutions				
a) Term Loans	0.00		0.00	
b) Interest Accrued and due	0.00	0.00	0.00	0.00
4. Banks				
a) Term Loans	0.00		0.00	
- Interest accrued and due	0.00		0.00	
b) Other Loans (Specify)	0.00		0.00	
- Interest accrued and due	0.00	0.00	0.00	0.00
5. Other Institutions and Agencies	0.00	0.00		0.00
6. Debentures and Bonds	0.00	0.00		0.00
7. Others (Specify)	0.00	0.00		0.00
TOTAL		**0.00**		**0.00**

Note: Amounts due within one year Nil

M.A.C.S's Agharkar Research Institute, Pune - 411 004
Schedules forming part of Balance Sheet as at 31.03.2012

Schedule 5 : Unsecured Loans and Borrowings

Amount - Rs.

Particulars	Current Year		Previous Year	
1. Central Government	0.00	0.00		0.00
2. State Government (Specify)	0.00	0.00		0.00
3. Financial Institutions	0.00	0.00		0.00
4. Banks		0.00		0.00
a) Term Loans	0.00	0.00	0.00	0.00
b) Other Loans (Specify)	0.00	0.00	0.00	0.00
5. Other Institutions and Agencies		0.00		0.00
6. Debentures and Bonds		0.00		0.00
7 Fixed Deposits		0.00		0.00
8. Others (Specify)		0.00		0.00
TOTAL		**0.00**		**0.00**

M.A.C.S's Agharkar Research Institute, Pune - 411 004
Schedules forming part of Balance Sheet as at 31.03.2012

Schedule 6 : Deferred Credit Liabilities

Amount - Rs.

Particulars	Current Year		Previous Year	
a) Acceptance secured by hypothecation of capital equipment and other assets	0.00	0.00	0.00	0.00
b) Others	0.00	0.00	0.00	0.00
TOTAL		**0.00**		**0.00**

Note: Amounts due within one year

M.A.C.S's Agharkar Research Institute, Pune - 411 004

Schedules forming part of Balance Sheet as at 31.03.2012

Schedule 7 : Current Liabilities & Provisions

Amount - Rs.

Particulars	Current Year		Previous Year	
A. Current Liabilities :-				
1. Acceptances	-		-	
2. Sundry Creditors:				
a) For Goods		520,390		1,025,372
3. Advances Received	-			
4. Interest Accrued but not due on:				
a) Secured Loans/borrowings	-			
b) Unsecured Loans/borrowings	-	-	-	-
5. Sundry Liabilities:				
a) Sales Tax	6,938		6,367	
b) Culture Identification charges	1,943,123		1,331,296	
c) Unpaid Salary	501,279		516,590	
d) Income Tax (Contractor)	33,412		34,706	
e) Service Tax	10,243		1,749	
f) Group Insurance	48,370		33,406	
g) LIC	69,618		67,744	
h) PF Commissioner A/c	447,360		682,486	
i) P.F.New Pension Scheme	88,027		445,054	
j) State Profession Tax	24,175		26,600	
k) Income tax (salary)	402,780	3,575,325	524,646	3,670,644
6. Other current Liabilities(Various Consultancies)		584,354	511,146	
Self Contribution - P.F.	-	-	15,165	526,311
7. Unspent Balance of Grant	-	43,844,570	43,956,171	
8. Earnest Money Deposit for Construction and Equipments	1,793,534		2,241,584	
9. Security deposit	1,113,469		1,331,598	
10 Other Titution Fees	28,898		13,014	
11. Recovery of Bank Loan	52,390		59,825	
12. DST PAC Meeting	163,610		163,610	
13. FIST Programme	546,809		546,809	
14. DST Straigernt Meeting	58,406		58,406	
15 DST Solar Meeting	128,254		-	
16. HCJMRI Project (Unspent Balance)	27,524		27,524	
17. Doodhpapeshwar Ltd. Project	29,049		84,050	
18. Organizing Group Meeting &Monitoring Committee	540		540	
19. DST Good Lab Practice Seminar	51,860		51,860	
20. Scheme	-		2,551,171	
21 Beej Infrastructure Facility	750,000		750,000	
Other Current Liabilities				
6th Pay Arrears	-		6,100,000	
Retention Money	179,489		244,534	
		4,923,832		58,180,696
Total (A)		**53,448,471**		**63,403,023**

Particulars	Current Year		Previous Year	
B. Provisions				
1. For Taxation	-		-	
2. Gratuity	51,164,369		50,589,114	
3. Superannuation/Pension	-			
4. Accumulated Leave Encashment	32,924,576		32,557,745	
5. Trade Warranties/Claims	-			
6. Others				
- Salary for March 2012	3,813,228		3,737,948	
- Audit fees	16,854		16,545	
- Seminar Expaenses	2,000			
- Electricity & Power	421,080		341,560	
- Postage & Telephone	40,638		29,362	
- Professioinal Charges	-		13,026	
- Vehicle maintainance	11,361		-	
- Campus maintainance	86,169		63,072	
- Legal Fees	24,000		12,000	
- Travelling expenses	22,706		15,506	
- Security Service Charges	91,737		71,659	
- Honararium	20,000		30,000	
- Water Charges	-		-	
- Database Expenses	217,855			
- Repairs and Maintenance of Building and Equipments	-		109,144	
- Information & Technology Services	-		439,202	
- Medical Expenses	62,968		-	
- Equipments	-		-	
- Generator Maintenance Charges	-		36,099	
- Subscription to Journals	98,162		-	
- Consultant Engineer's Pay	-		18,000	
- Books	-		98,673	
- Purchases	331,377		1,320	
- Science Day Expenses	5,618		1,710	
- Reimbursement of Tuition fee	30,520		-	
- Liveries	41,160			
- Farm Expenses	130,548		2,048	
- Field Tour	-		638	
- Hired Labour Charges	184,968		42,826	5,080,338
- Service Contract	15,150			
- Deposit Linkied Insurance Fund	2,895			
- Leave Travel Concession	2,788			
- Reimbursement of Medical Expenses of Retired Staff Members	17,429			
- P.F. & N.P.S.	439,594			
- P.F. & N.P.S. Adm. Charges	36,414			
- Reimbursement of Telephone Expenses	44,240	6,211,459		
- ARI Staff TDS Refundable		8,381		
Total (B)		**90,308,785**		**88,227,197**
Total (A+B)	**-**	**143,757,256**		**151,630,220**

M.A.C.S's Agharkar Research Institute, Pune - 411 004

Schedules forming part of Balance Sheet as at 31.03.2012

Schedule 8 : Fixed Assets

Amount - Rs.

Description	Gross Block						Depreciation					Net Block	
	Cost/valuation As at beginning of the year	Rate of Dep.	Additions during the year	Deletions during the year	Net cost as on 31.3.2012	Cost valuation at the year-end	As at the beginning of the year	Depreciation on the opening cost	Dep. on Additions during the year	Total dep. duing the year	Total up to the Year-end	As at the Current year-end	As at the Previous year-end.
A. FIXED ASSETS:													
1. LAND													
a) Freehold	174,914	Nil	-		-	174,914	-				-	174,914	174,914
b) Leasehold	-	Nil	-		-	-	-				-	-	
2. BUILDINGS:				-	-								
a) On Freehold	45,851,704	2.5%	16,831,126		16,831,126	62,682,830	9,338,982	1,146,293	420,778	1,567,071	10,906,053	51,776,777	36,512,722
b) On Leasehold	-	Nil	-		-	-	-	-	-	-	-	-	
c) Ownership Flats/Premises	-		-		-	-	-	-	-	-	-	-	
d) Superstructures on Land and not beloging to the entity	-	Nil	-		-	-	-	-	-	-	-	-	
e) Temprory Structures	1,727,873	2.5%	-		-	1,727,873	438,339	43,197	-	43,197	481,536	1,246,337	1,289,534
f) Shed and glasshouse at Hol	628	5%	-		-	628	613	14	-	14	627	1	15
3. PLANT MACHINERY & EQUIPMENT					-	-			-	-	-		
a) Equipment at Hol	54,578	10%	-		-	54,578	54,577	1	-	1	54,578	-	1
b) Equipments at Pune	183,920,897	20%	5,059,008	1,428,077	3,630,931	187,551,828	181,745,599	1	726,186	726,187	182,471,786	5,080,042	2,175,298
4. VEHICLES	1,791,407	20%	-		-	1,791,407	1,791,406	1	-	1	1,791,407	-	1
5. FURNITURE, FIXTURES	12,320,856	10%	381,996		381,996	12,702,852	11,429,649	1,232,086	38,200	1,270,285	12,699,934	2,918	891,207
MODULAR FURNITURE- NEW LAB		10%	7,810,160		7,810,160	7,810,160		-	781,016	781,016	781,016	7,029,144	-
6. COMPUTER/PERIPHERALS	9,881,348	20%	590,089		590,089	10,471,437	9,638,537	1	118,018	118,019	9,756,556	714,881	242,811
7. ELECTRIC INSTALLATIONS	2,983,737	10%	-		-	2,983,737	2,478,324	298,374	-	298,374	2,776,698	207,039	505,413
8. TRANSFORMER	1,491,549	15%	-		-	1,491,549	1,491,548	1	-	1	1,491,549	-	1
9. LIBRARY BOOKS	6,264,765	20%	165,381	128,103	37,278	6,302,043	5,937,354	1	7,456	7,457	5,944,811	357,232	327,411
10. TUBEWELLS& W.SUPPLY	112,538	2.5%	-		-	112,538	64,244	2,813	-	2,813	67,057	45,481	48,294
11. SOLAR SYSTEM HOSTEL	76,500	10%	90,879		90,879	167,379	76,499	7,650	9,088	16,738	93,237	74,142	1
12. OTHER FIXED ASSETS	5,399,852	2.5%	-		-	5,399,852	1,085,681	134,996	-	134,996	1,220,677	4,179,175	4,314,171
13. CONST.OF H.T.SUBSTATION	4,759,851	2.5%	36,000		36,000	4,795,851	118,996	118,996	900	119,896	238,892	4,556,959	4,640,855
TOTAL OF CURRENT YEAR	**276,812,997**		**30,964,639**	**1,556,180**		**306,221,456**	**225,690,348**	**2,984,425**	**2,101,641**	**5,086,066**	**230,776,414**	**75,445,042**	**51,122,649**
PREVIOUS YEAR	**268,777,794**		**8,035,266**	**63**		**276,812,997**	**221,226,532**	**2,258,604**	**1,102,606**	**4,463,815**	**225,690,347**	**5,122,649**	**47,551,202**
TOTAL	**276,812,997**		**30,964,639**	**1,556,180**	**-**	**306,221,456**	**225,690,348**	**2,984,425**	**2,101,641**	**5,086,066**	**230,776,414**	**75,445,042**	**51,122,649**

Note : The afforsaid expenditure is incurred out of Govt. Grants, disposal of which is subject to conditions attached to these Grants

M.A.C.S's Agharkar Research Institute, Pune - 411 004
Schedules forming part of Balance Sheet as at 31.03.2012

Schedule 9 : Investments from Earmarked/ Endowment Funds (Long Term)

Amount - Rs.

Particulars	Current Year	Previous Year
1. In Government Securities	-	-
2. Other approved Securities(Templeton Mutual Fund)	-	
3. Shares	-	
4. Debentures and Bonds(IRBI bond) (Dr.A.B.Joshi Donation)		265,000
5. Subsidiaries and Joint Ventures		
6. Others (Fixed Deposits) (Dr. A.D.Agate Donation)	5,176	5,176
7. Others (Fixed Deposits from Technology Development Fund A/c:SBI & UBI) (F.D. with SBI Rs.24189569 + F.D. with UBI Rs. 7355158)	31,544,727	
8 Others(Fixed Depositwith Union Bank of India) (includes accrued interest of Rs.436907/-)	40,436,907	17,422,820
TOTAL	**71,986,810**	**17,692,996**

M.A.C.S's Agharkar Research Institute, Pune - 411 004
Schedules forming part of Balance Sheet as at 31.03.2012

Schedule 10 : Investments - Others

Amount - Rs.

Particulars	Current Year		Previous Year	
1. In Government Securities	0.00	0.00	0.00	0.00
2. Other approved Securities	0.00	0.00	0.00	0.00
3. Shares	0.00	0.00	0.00	0.00
4. Debentures and Bonds	0.00	0.00	0.00	0.00
5. Subsidiaries and Joint Ventures	0.00	0.00	0.00	0.00
TOTAL	**0.00**	**0.00**	**0.00**	**0.00**

M.A.C.S's Agharkar Research Institute, Pune - 411 004
Schedules forming part of Balance Sheet as at 31.03.2012

Schedule 11 : Current Assets, Loans & Advances

Amount - Rs.

Particulars	Current Year		Previous Year	
A. CURRENT ASSETS:				
1. Inventories:				
a) Stores and Spares				
b) Publications	26,577		26,577	
c) Stock-in-trade of consumables(as taken valued and certified by the Management)	81,482	108,059	77,257	103,834
2. Sundry Debtors:	-			
a) Debts Outstanding for a period exceeding six months	-	-		
b) DBT Monitoring Meeting	48,156		48,156	
-Receivable from staff(Animal house Tender form)	3,140		3,140	
c) Brain storming Session	166,602	217,898	166,602	217,898
3. Cash balances in hand(including cheques/drafts and imprest)		24,299		21,538

Particulars	Current Year		Previous Year	
4. Bank Balances:				
a) With scheduled Banks			60,132,034	
- On Current Accounts	10,373,025			
- On Deposit Accounts(CLTD A/c)	-			
- On Savings Accounts	17,641,837			
- On Savings Accounts(TDF)	756,468	28,771,330		-
b) With non-Scheduled Banks:	-			
- On Current Accounts	-		-	
- On Deposit Accounts	-		-	
- On Savings Accounts	-		-	-
5. F.D. Against L/C.		1,421,919		8,697,134
6. Dr. Acharya		181		
7. Amount receivable from Schemes		4,816,310		
TOTAL (A)		**35,359,996**		**69,172,438**
B.LOANS,ADVANCES AND OTHER ASSETS				
1. Loans:				
a) Staff (For HBA & Vehicle Advance)		1,179,824	1,689,566	
b) Other Entities engaged in activities/ objectives similar to that of the Entity			- -	
c) Amount receivable from Schemes - NPS	-	-	223,789	
d) Amount receivable from Schemes - TDF	-	-	47,488	1,960,843
2. Advances and other amounts recoverable in cash or in kind or for value to be received:				
a) On Capital & Revenue Expenditure	18,550,888		37,553,170	
b) Prepayments(Cash Insurance)	1,164		862	
c) Advances to staff (For TA etc)	728,957		368,433	
d) Prepaid Medical Insurance Premium	48,620		13,328	
e) Prepaid Database Expenses	-		807,748	
f) Prepaid subscriptions for journals	5,682,049		2,431,098	
g) Deposits kept with third parties	824,941	25,836,619	829,941	42,004,580
3. Income Accrued:				
a) On Investments from Earmarked/ Endowment Funds		-		
b) On CLTD A/C Others		-		
c) On Loans and Advances(HBA & Vehicle Adv)		-		
d) Accured int on Technology Dev Fund Account				
e) Amount receivable from INDO-TUNISIA	56,400	56,400		
f) Interest on F.D.R. - Union Bank of India 11,506				
4. Claims Receivable (TDS)	439,920		516,212	
5. Amount Receivable -Adv.given to MEF Scheme Staff	-			
6. Overhead Charges receivable			102,000	
7. Kumar Krishi Mitra Fellowship	31,281		31,281	
8. Royalty Receivable	10,000		10,000	
9. Vigyan Prasar	-			
10. Amount Receivable from MACS	503,767	996,474	25,030	740,923
TOTAL (B)		**28,069,317**		**44,706,346**
TOTAL (A+B)		**63,429,313**		**113,878,784**

M.A.C.S's Agharkar Research Institute, Pune - 414 004

Income and Expenditure Account for The Year Ended 31.03.2012

Amount - Rs.

Particulars	Schedule	Current Year	Previous Year
Income			
Income from Sales/Services	12	595,115	551,234
Grants/Subsidies	13	136,411,601	111,273,707
Fees/Subscriptions	14	236,803	118,733
Income from Investments(Income on Invest. From earmarked/ endowment Funds transferred to Funds)	15	-	-
Income from Royalty,Publications etc.	16	54,484	109,915
Interest Earned	17	2,456,841	2,940,980
Other Income	18	363,943	668,301
Increase/(decrease) in stock of Laboratory consumables	19	4,225	3,691
Donation Received in kind (Equipment)		120,183	
Total (A)		**140,243,195**	**115,666,56**
Expenditure			
Establishment Expenses	20	87,897,859	87,272,566
Other Administrative Expenses etc.	21	21,759,712	20,755,660
Expenditure on Grants, Subsidies etc.	22	-	-
Interest	23	-	-
Depreciation (Net Total at the year-end- corresponding to schedule 8)	8	5,086,066	4,463,815
Amount paid to Technology Development Fund for 6th Pay			-
Total (B)		**114,743,637**	**112,492,041**
Balance being excess of Income over Expenditure (A-B)		25,499,558	3,174,519
Transfer to Trust fund (for capital expenditure Schedule D)		49,515,527	44,775,654
BALANCE BEING SURPLUS/(DEFICIT)CARRIED TO		49,515,527	44,775,654
CORPUS/CAPITAL FUND		**(24,015,969)**	**(41,601,135)**
SIGNIFICANT ACCOUNTING POLICIES	24		
CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS	25		

Note: We hereby certify that the above Income & Expenditure account is correct to the best of our knowledge and belief.
Note : Previous year's figures are regrouped wherever necessary

As per our report of even date

For PATKI & SOMAN,
Chartered Accountants

Sd/-
Sqn. Ldr. S. Francis (Retd)
Finance & Accounts Officer
ARI

Sd/-
D. R. Ranade
Officating Director
ARI

Sd/-

Partner
21 Sept. 2012

M.A.C.S's Agharkar Research Institute, Pune - 411 004

Schedules forming part of Income and Expenditure Account for the year ended 31.03.2012

Schedule 12 : Income from Sales/Services

Amount - Rs.

Particulars	Current Year	Previous Year
1. Income from Sales		
a) Sales of Finished Goods (Farm Produce)	594,525	550,058
b) Sale of Raw Material	-	
c) Sale of Scraps	-	-
2. Income from Services		
a) Service Charges	580	580
b) SEM Charges	-	-
c) Maintenance Services (Equipment/Property)	-	-
d) Others (Currency Fluctuation Adjustment)	-	-
e) Fees for Information	10	596
Total (Rs.)	**595,115**	**551,234**

M.A.C.S's Agharkar Research Institute, Pune - 411 004

Schedules forming part of Income and Expenditure Account for the year ended 31.03.2012

Schedule 13 : Grants/Subsidies

Amount - Rs.

Particulars	Current Year	Previous Year
1. Central Government	136,300,000	131,695,600
Add: Unspent balance at the beginning of the year	43,956,171	23,534,278
Less: Unspent balance at the year end	43,844,570	43,956,171
	136,411,601	**111,273,707**
2. State Government	0	0
3. Government Agencies	0	0
4. Institutions/Welfare Bodies	0	0
5. International Organisations		0
6. Others (Specify)	0	0
Net Surplus of sale of Assets		
Total (Rs.)	**136,411,601**	**111,273,707**

M.A.C.S's Agharkar Research Institute, Pune - 411 004

Schedules forming part of Income and Expenditure Account for the year ended 31.03.2012

Schedule 14 : Fees/Subscriptions

Amount - Rs.

Particulars	Current Year	Previous Year
1. Entrance Fees (Library Membership fees)	34,310	30,352
2. Annual Fees(Licence fees)/Subscriptions	12,346	12,345
3. Seminar/Program Fees	-	-
4. Others (Ph.D.Tuition fee, Ph..D.Provisional Admission fee)	190,147	76,036
Total (Rs.)	**236,803**	**118,733**

M.A.C.S's Agharkar Research Institute, Pune - 411 004
Schedules forming part of Income and Expenditure Account for the year ended 31.03.2012

Schedule 15 : Income from Investments

(Income on Invest From Earmarked/Endowment Funds transferred to Funds)

Amount - Rs.

Particulars	Investment From Earmarked Fund		Investment - Others	
	Current Year	Previous Year	Current Year	Previous Year
1. Interest				
a) On Govt. Securities	0.00		0.00	0.00
b) Other Bonds/Debentures			0.00	0.00
2. Dividends.				
a) On Shares	0.00		0.00	0.00
b) On Mutual Fund Securities	0.00		0.00	0.00
3. Rents	0.00		0.00	0.00
4. Others(Interest on bank deposits)	0.00		0.00	0.00
TOTAL	**0.00**	**0.00**	**0.00**	**0.00**
Transferred to Earmarked/Endowment Fund	**0.00**	**0.00**	**0.00**	**0.00**

M.A.C.S's Agharkar Research Institute, Pune - 411 004
Schedules forming part of Income and Expenditure Account for the year ended 31.03.2012

Schedule 16 : Income from Royalty, Publication etc.

Amount - Rs.

Particulars	Current Year	Previous Year
1. Income from Royalty	-	-
2. Income from Publications	7,084	19,865
3. Others (Sale of Tender Forms/I Cards)	30,600	13,500
4. Application Money	16,800	76,550
Total (Rs.)	**54,484**	**109,915**

M.A.C.S's Agharkar Research Institute, Pune - 411 004
Schedules forming part of Income and Expenditure Account for the year ended 31.03.2012

Schedule 17 : Interest Earned

Amount - Rs.

Particulars	Current Year	Previous Year
1. On Term Deposits		
a) With Scheduled Banks	-	
b) With Non-Scheduled Banks	1,528,666	1,369,410
c) With Institutions	-	-
2. On Saving Accounts	832,800	
a) With Scheduled Banks		-
b) With Non-Scheduled Banks		1,459,895
c) Post Office Savings Accounts		
d) Others M.S.E.B Deposit	31,413	29,181
3. On Loans		
a) Employees/Staff (On HBA & Vehicle Advance)	63,962	82,171
b) Others (Interest on LTC Advance)	-	323
4. Interest on Debtors and Other Receivables	-	-
Total (Rs.)	**2,456,841**	**2,940,980**

M.A.C.S's Agharkar Research Institute, Pune - 411 004
Schedules forming part of Income and Expenditure Account for the year ended 31.03.2012

Schedule 18 : Other Income

Amount - Rs.

Particulars	Current Year	Previous Year
1) Profit on Sale/Disposal of Assets:		
a) Owned Assets (Sale of Mahindra Jeep)	55,501	-
b) Assets acquired out of grants, or received free of cost	-	-
2) Export Incentives realized		-
3) Fees for Miscellaneous Services	-	-
4) Miscellaneous Income	5,304	4,532
5) Lab Space Usage Charge	-	-
6) Guest House Receipts	23,888	83,150
7) Hostel Fees Received	31,925	18,375
8) Recovery of Computer Software	-	
9) Medical Scheme for Retired staff	244,800	432,875
10) Late Fee for Ph.D.Tuition Fee	2,525	1,500
12) F.D.Against L.C.	-	127,869
Total (Rs.)	**363,943**	**668,301**

M.A.C.S's Agharkar Research Institute, Pune - 411 004
Schedules forming part of Income and Expenditure Account for the year ended 31.03.2012

Schedule 19 : Increase (decrease) in Stock of Finished Goods & Work in Progress

Amount - Rs.

Particulars	Current Year	Previous Year
a) Closing stock		
- Laboratory Consumables	81,482	77,257
- Finished Goods		
- Publications	26,577	26,577
	108,059	103,834
b) Less: Opening Stock		
- Laboratory Consumables	77,257	73,566
- Finished Goods		
- Publications	26,577	26,577
	103,834	100,143
Net Increase/(Decrease)	**4,225**	**3,691**

M.A.C.S's Agharkar Research Institute, Pune - 411 004
Schedules forming part of Income and Expenditure Account for the year ended 31.03.2012

Schedule 20 : Establishment Expenses

Amount - Rs.

Particulars	Current Year	Previous Year
1) Salaries and Wages	60,963,759	61,974,125
2) Allowances and Bonus	225,373	243,219
3) Contribution to Provident Fund & New Pension Scheme	6,266,572	5,759,369
4) Contribution to Other Fund (D.L.I.F.)	38,036	42,708
5) Staff Welfare Expenses	1,828,853	1,719,756
6) Expenses on Employees Reitrement and Terminal Benefits	11,885,098	11,584,226
7) Stipend to Trainees	3,456,364	2,897,286
10) Encashment of Earned Leave for LTC	409,888	640,647
11) Reimbursement of Residential Telephone Expenses	198,639	385,154
12) Consultant 's Payment	-	43,000
13) Fellowship & Research Associateship	2,158,984	1,491,517
14) P.F. and N.P.S. Admn.Charges	466,293	491,559
	87,897,859	**87,272,566**

M.A.C.S's Agharkar Research Institute, Pune - 411 004

Schedules forming part of Income and Expenditure Account for the year ended 31.03.2012

Schedule 21 : Other Administrative Expenses

Amount - Rs.

Particulars	Current Year	Previous Year
ADVERTISEMENT & PUBLICITY	44,962	289,646
AUDITORS REMUNERATION	21,854	16,545
BANK CHARGES	9,852	12,311
CAMPUS MAINT. EXPS	798,071	657,761
CONSULTANTS ENGINEERS HONORARIUM	206,000	181,613
CASH INSURANCE	3,190	3,329
DECREE AWARD PAYMENT	-	-
ELECTRICITY & POWER	4,596,868	4,014,600
FARM EXPS	833,921	699,537
FIELD TOUR	80,925	264,360
GARDEN EXPS	6,123	1,710
HONORARIUM	241,500	312,500
HOSPITALITY EXPS	114,284	170,751
INFORMATION TECH & NETWORKING	945,513	1,343,513
LABOUR & PROCESSING EXPS	168,998	85,865
LEGAL FEES	89,000	57,000
LIB MISC EXPS	28,875	47,498
LIVERIES	47,109	2,290
HIRED LABOUR CHARGES	2,935,366	2,106,210
NATIONAL TECHNOLOGY DAY EXPENSES		1,755
RECOGNITION FEE	12,000	12,000
RENEWAL OF RECOGNITION FEE	-	66,000
OFFICE EXPS MISC	71,549	75,606
PATENT CHARGES	12,800	30,000
POSTAGE, TELEPHONE & COMMUNICATION CHARGES	270,587	400,614
PRINTING & STATIONERY	652,025	865,497
PROFESSIONAL FEES	26,677	66,226
PROF S P AGHARKAR DAY EXPS	12,030	19,967
PROPERTY TAX	343,550	351,828
PURCHASES OF CHEMICALS & GLASSWARE	3,324,603	2,447,572
REPAIRS AND MAINTANANCE	1,642,903	2,291,432
Balance C/D	17,541,135	16,895,536
Balance B/D	17,541,135	16,895,536
HINDI DAY EXPENSES	800	1,000
SCIENCE DAY EXPS	63,564	57,372
SECURITY SERVICE CHARGES	1,097,509	799,009
SEM CHARGES	-	9,000
SEMINAR EXPS	22,344	83,639
SUBSCRIPTION EXPS	241,520	1,034,568
TA/CONVEYANCE--INDIAN AND FOREIGN TOUR	478,299	1,293,557
VIGILANCE WEEK EXPS.	1,560	968
VEHICLE RUNNING AND MAINT EXPS	129,433	156,979
		41,858
WATER CHARGES	1,155,295	306,742
COMPUTER RENT	-	2,000
DATA BASE EXPENSES	1,025,603	73,432
MEMBERSHIP FEE		2,650
TOTAL (Rs.)	**21,759,712**	**20,755,660**

M.A.C.S's Agharkar Research Institute, Pune - 411 004

Schedules forming part of Income and Expenditure Account for the year ended 31.03.2012

Schedule 22 : Expenditure on Grants, Subsidies etc.

Amount - Rs.

Particulars	Current Year		Previous Year	
a) Grants given to Institutions/Organisations	0.00	0.00	0.00	0.00
b) Subsidies given to Institutions/Organisations	0.00	0.00	0.00	0.00
TOTAL		**0.00**		**0.00**

Note : Name of the Entries, their Activities along with the amount of Grants/ Subsidies are to be disclosed.

M.A.C.S's Agharkar Research Institute, Pune - 411 004

Schedules forming part of Income and Expenditure Account for the year ended 31.03.2012

Schedule 23 : Interest

Amount - Rs.

Particulars	Current Year		Previous Year	
a) On Fixed Loans	0.00	0.00	0.00	0.00
b) On Other Loans (including Bank Charges)	0.00	0.00	0.00	0.00
c) Others (Specify)				
TOTAL		**0.00**		**0.00**

FORM OF FINANCIAL STATEMENTS : Non- profit making organization

NAME OF ENTITY : MACS'S Agharkar Research Institute Pune, 411004

Schedules forming part of The Accounts for the period ended 31st March 2012

Schedule 24 : Significant Accounting Policies

a. ACCOUNTING CONVENTIONS :

The financial statements are prepared under the historical cost convention and in accordance with the applicable Accounting Standards except where otherwise stated. Accrual system of Accounting is generally followed to record income the transaction in the Financial Statements.

b. FIXED ASSETS :

Fixed Assets are stated at their original cost of acquisition, less depreciation.

c. METHOD OF DEPRECIATION :

Depreciation on fixed assets has been provided on Straight Line Basis (SLM) as per the rates Prescribed under Bombay Public Trust Act, 1950.

It is not possible for us to verify the actual date of asset put to use and hence the same has been taken on the basis of information and explanation given by the Management. Accordingly depreciation is calculated irrespective of put to use for the whole year.

d. Extra-Ordinary Items, Prior Period Items, Changes in Accounting Policies

On the basis of information and explanation given by the Management Extra-Ordinary Items, Prior Period Items, Changes in Accounting Policies are not separately disclosed in the Financial Statement but are integrated through various items appearing under the same.

e. FOREIGN CURRENCY TRANSACTIONS:

Transactions denominated in foreign currency are accounted as the exchange rate prevailing at the date of the transaction; however foreign exchange gain loss is not calculated and accounted for.

f. INVESTMENTS :

1. Long term investments are valued at cost and wherever required, Provision is made for permanent diminution in the value of such investments.
2. Investments classified as "Current" are valued at lower of cost and market value.
3. Cost means acquiring cost which includes acquisition expenses like brokerage, transfer stamps, etc.

g. Revenue Recognition :

1. All Revenue receipts are generally on accrual basis.
2. All Expenses are generally accounted for on accrual basis.

h. Accounting for Government Grants :

1. Government grants of the nature of contribution towards capital cost of setting up projects as capital reserve.
2. Grant in respect of specific assets acquired are shown as a deduction from the cost of related assets.
3. Government grants/subsidies are generally accounted on accrual basis.
4. Government grants are given for seminars are in revenue nature revenue nature but directly taken to Current asset and expenditure is booked against it so as to determine shortage or excess if any.

i. Retirement Benefits :

1. Generally, liability towards gratuity payable on death/retirement and leave encashment of the employees is provided based on Actuarial Valuation.
2. Provision for accumulated leave encashment benefit to the employees is accrued and computed on the assumption that employees are entitled to receive the benefit as each year end which is also done on Actuarial Valuation.

j. Capitalisation:

All direct expenses attributable to fixed asset acquired are capitalised.

As per our report of even date

For PATKI & SOMAN,
Chartered Accountants

Sd/-	Sd/-	Sd/-
Sqn. Ldr. S. Francis (Retd)	**D. R. Ranade**	
Finance & Accounts Officer	Officating Director	
ARI	ARI	Partner
		21 Sept. 2012

FORM OF FINANCIAL STATEMENTS : Non- profit making organization

NAME OF ENTITY : MACS'S Agharkar Research Institute Pune, 411004

Schedules forming part of The Accounts for the period ended 31st March 2012

Schedule 25 : Contingent Liabilities and Notes on Accounts (Illustrative)

1. Contingent liability:
   a) Claims against the entity not acknowledge as debts-Nil (Previous Year-Nil)
   b) In respect of:
      - Bank guarantee given by on behalf of the entity -N.A. (Previous Year-Nil)
      - Letters of credit opened by bank behalf of the entity-.Nil(Previous Year-Rs.95.15 Lacs)
      - Bill discounted with banks -Nil (Previous Year-Nil)
   c) Disputed demands in respect of:
      - Income tax -Nil (previous Year-Nil) Sales tax -Nil (Previous Year-Nil)
      - Municipal Taxes -Nil (Previous Year-Nil)
   d) In respect of claims from parties for non-execution of orders, but contested by the entity - Nil (Previous Year-Nil)
2. Capital Commitments:

   Estimated value of contracts remaining to be executed on capital account and not provided for (Net of Advances) Nil(Previous Year)-Nil
3. Lease obligation

   Further obligation for rental under finance lease arrangements for plant and machinery is Nil (previous Year Nil)
4. Currants Asset, Loans And Advances :

   In the opinion of the management, the current assets, loans and advances have a value on realization in the ordinary course of business, equal to the aggregate amount shown in the Balance Sheet. Some of balance of sundry debtors, deposits, loans and advances are subject to confirmation from the respective parties and consequential reconciliation/adjustments arising there from, if any. Advances of-Rs.3.52 Lacs paid to clearing house agent M/s. Flyjack Logistics is not likely to be received/settle as the said party is not accepting the dues. Except to this management doesn't expect any material variation.
5. Taxation

   In view of there being no taxable income under Income Tax Act 1961, No provision for income tax has been considered necessary. In view of this, no disclosure is required as per accounting standards -22 issued by The Institute of Chartered Accountants of IndiaJTCAI).
6. Grants:

   During the year, The Institute has received revenue as well as capital grants from government. The accounts of such grants are disclosed in financial statements as per AS-12 issued by Institute of Chartered Accountants India (ICAI) except grants which are received from DST for meetings/seminar which are of revenue nature are routed through Balance Sheet rather than Income & Expenditure.
7. Retirement Benefit:

   Generally, liability towards gratuity payable on death/retirement of employees is provided based on Actuarial Valuation and provision for accumulated leave encashment benefit to the employees is accrued and computed on the assumption that employees are entitled to receive the benefit at each year end which is also done on Actuarial Valuation.-

The principle assumption used in determining the gratuity obligation are as below: -

Sr. No.	Particulars	For year ended 31st March, 2012
1.	Withdrawal Rate	2.00%
2.	Discounting Rate	8.50%
3.	Future Salary Rate	5.00%

The position of gratuity payable on death/retirement of employees and leave encashment as on 31st March, 2012 is as below

Particulars	Provision for Gratuity	Provision for Leave Encashment
Opening balance as on 3 1st 201 1	50,589,114.00	32,557,745.00
Add:- Addition during the year 201 1-12.	575,255.00	366,831.00
Less:- Deduction during the year 201 1-12.		-
Closing Balance as on 3 1st March 2012.	51,164,369.00	32,924,576.00

8. Impairment of Assets :

As per Accounting Standard-28 "Impairment of Assets" issued by the institute of Chartered India, comes in to effect, in respect of accounting commencing on or after 1st April, 2005. We have relied upon the management on the matters related to impairment of assets, in view of management there are no impairment losses.

9. During the year 2008-2009, a scanning Electron Microscope amounting to Rs. 89.00 lacs was purchased for ARI, common facility, which was not yet installed and made operative. This clearly has major financial implication and may delay the future cash inflow generation from the said Equipment.

10. Previous year figure are rearranged, recast or regrouped wherever necessary, to make them comparable which those of the year under audit.

11. Third party confirmation are necessary for confirming the balances appearing in the books of account and also long outstanding of balances as at the Balance Sheet date, but institute was not able to provide any of such confirmation to us. Hence, we are unable to comment on the accuracy of such third party balances.

12. Provisions are recognised when the firm has present obligation as a result of past event; it is more likely that an outflow resources will be required to settle the obligation; and the amount has been reliably estimated.

13. Opening Inter balances of ARI-MACS -SCHEMES are not matching. Also during the year transactions are not matching. No reply has been received from the Institute in this regard.

14. In case of items debited to Income and Expenditure account, it was informed to us that the expenditure is not of capital nature.

As per our report of even date

Sd/-
For PATKI & SOMAN,
Chartered Accountants
Partner
21 Sept. 2012

M.A.C.S's Agharkar Research Institute, Pune - 411 004

Schedules forming part of Balance Sheet as at 31.03.2012

Schedule D

Amount - Rs.

Particulars	Current Year		Previous Year	
Other Fixed Assets				
Solar Systems	90,879			
Modular furniture for New Lab Bldg	7,810,160			
Books	165,381		409,343	
Construction of Buildings	16,831,126		236,856	
Computer / Peripherials/Softwares	590,089		2,219,080	
Electric Fittings	-		51,000	
Office Furniture & Dead Stock	381,996		77,897	
Other Fixed Assets	-		571,433	
Construction of HT Substation	36,000		1,750,535	
App. & Equipments	5059008	30,964,639	2719122	8,035,266
		30,964,639		8,035,266
Advance to Supplier for Equipments				
A.O.Joiont Comm. Of Animal Husbandory			(3,900)	
A D Instruments	(5,230)			
Dass Electric Trading Co.			25,400	
Freight Express	158,349		158,349	
Haytrans India Ltd.			(15,857)	
Inkroma	1,809,600		1,809,600	
Mapple ESM Technologies Ltd.	121,500		121,500	
NewBrunswick Sci Co	1,000		1,000	
Signet Communications Pvt Ltd				
. Licer Inc.	3,822,990		3,822,990	
Anand Agencies	-			
Anton Paar			15,860	
Applied Separations Inc.	2,113,139		2,113,139	
Applied Separations Inc.				
AVECO VISCOMM			(1,534)	
Balmer Lawrie & Co. Ltd.			50,936	
Barnstead International				
Bharat Chemicals	5,027			
Bioresoure Biotech Pvt.Ltd.			12,971	
Bruker Axs Analytical Inst.Pvt.Ltd.	140,000		140,000	
C. DAC 158,673	158,673			
Camag - Switzerland	1,059,057		1,059,057	
Carl Zeiss	6,234,768		6,234,768	
C-Dot Systems P. Ltd.			83,492	
Coulbourn Instruments			16,330	
CPWD	18,070,564			
Director CIMAP Lucknow			6,000	
Director TMC Actrec	1,500		1,500	
Dr.Alka Mehta			(1,103)	
Dr.B.V.Rao IPMT	7,288		7,288	
Easy Comp Solutions	11,250		11,250	
Eppemndorf A G	-			

Particulars	Current Year		Previous Year	
FlyJac Logistics	352,516		352,516	
great Wall Corporate Services			2,910	
Girikand Travel	36,869			
Growtech	124,440		124,440	
Intelligent Systems			22,460	
Invitrogen Bioservices Pvt.Ltd.			21,476	
Jeico Tech Co.Ltd.			(544,203)	
Khadi Gramodyog Seva			15,218	
Kubota Corporation			6,020	
Locuz Enterprises			(85,612)	
Micromax Systems			3,000	
National Botanical Res.Institute	4,613		4,613	
National Co-op.Cconsumer's Federation			(8,297)	
Nimbalkar R.P.			21,000	
Olympus				
Oxford Instruments Analyticals	1,310,418		1,310,418	
PSP Freight Lines Pvt.Ltd.	151,405		151,405	
Precious Scientific &Surgicals	2,750			
Ranade S.M			15,000	
Ricoh India Ltd.			2,183	
Roche Diagnostics Asia Pvt.Ltd.			1,674	
Raut Scientific & Surgicals	10,904			
S Usha			(613)	
S.V.Instruments Analyticals				
Sanprints			14,612	
Schindler India Ltd.	831,300		831,300	
Shubham Diagnostics			(29,062)	
Sine Waves Computer services	8,320		8,320	
Sterling Chemicals & Alcohol			38,400	
Sun Enviro			1,275	
Synoptics Ltd.			(2,470)	
Shri Sai Traders	800		-	
Sigma Aldrich Chemicals	34,099		-	
Vijay Chemicals	25,843			
Ratanmohan	2,866		-	
Techcomp Ltd.			422,619	
Khadi Gramodyog Seva	15,218		-	-
Veeco Asia Pvt. Ltd.			140,747	
UPS Jetairexpress Pvt.Ltd.			5,013	
Sunad Services	(384)	18,550,888	(4,247)	36,740,388
TOTAL		**49,515,527**		**44,775,654**

As per our report of even date

Sd/-
Sqn. Ldr. S. Francis (Retd)
Finance & Accounts Officer
ARI

Sd/-
D. R. Ranade
Officating Director
ARI

For PATKI & SOMAN,
Sd/-
Chartered Accountants

Partner
21 Sept. 2012