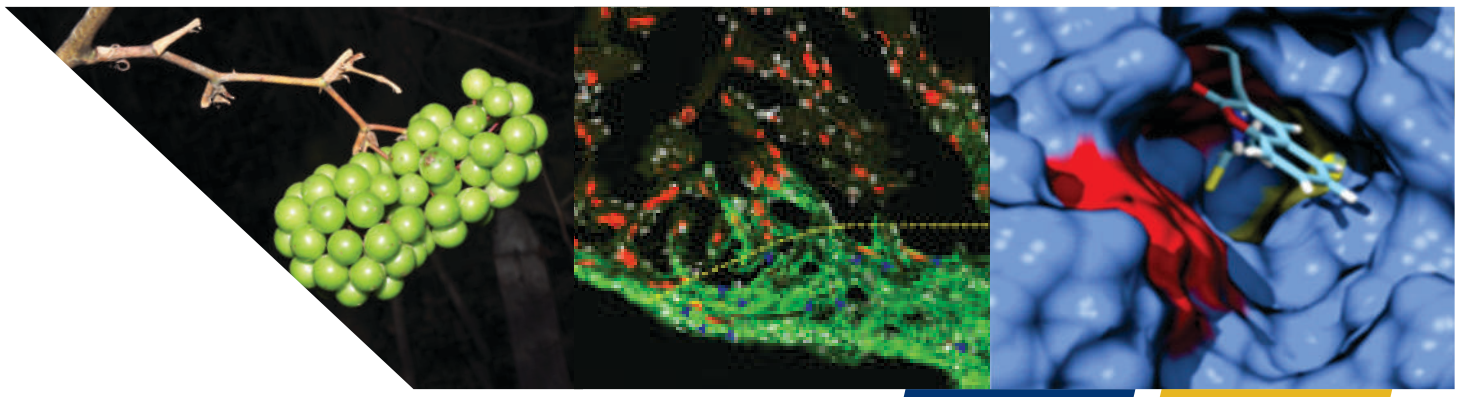
MACS

Annual Report 2020-21



Maharashtra Association for the Cultivation of Science
Agharkar Research Institute

Vision

To excel as an internationally recognized centre of multi-disciplinary research in science and technology

Mission

a. Conduct basic and applied research in life and related sciences for human betterment
b. Explore the genetic diversity of microbes, plants and animals
c. Develop sustainable technologies for a cleaner environment, agriculture and better health

Objectives

a. Undertake research in cutting-edge science and its applications
b. Develop and translate technologies for cleaner environment and better health
c. Develop and adopt practices for sustainable agriculture

Annual Report
2020-21

Maharashtra Association for the Cultivation of Science
Agharkar Research Institute

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Mr Abdul Rahman, Administrative Officer
(Up to 2.7.2020)

Mr P.V. Gosavi, Stores and Purchase Officer
(From 3.7.2020 onwards)

Grievance Officer, ARI

Dr. GK Wagh

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Foreword

Dr. Anil Kakodkar
President
Maharashtra Association for the Cultivation of Science
Pune

Dear Colleagues,

Maharashtra Association for the Cultivation of Science is now in its 75th Anniversary Year. My greetings to all of you on the occasion. Our founders have raised this institution from scratch under challenging circumstances primarily driven by passion for seeding a conducive scientific research ambiance in Pune. We express our deepest respects to them. Several distinguished personalities have nurtured this institution over years. I would like to acknowledge their contributions in taking the institution to its present stature. Department of Science & Technology, Government of India, have adopted MACS-ARI as its autonomous institute. We express our gratitude to them.

MACS – ARI pursues a broad spectrum of research ranging from nanoscale to a macro scale and from fossils to living forms. MACS – ARI research is primarily focussed along six verticals.

- Biodiversity & Paleobiology
- Bioprospecting
- Genetics & Plant Breeding and
- Bioenergy
- Developmental Biology
- Nano-bioscience

The research at MACS-ARI is a healthy mix of fundamental and applied research. While the institute has earned a name for itself for excellence in research in all these areas, the extramural research projects executed by the MACS-ARI scientists have made a significant contribution to Indian Science. There is also a significant component of industry sponsored research and technology development which hopefully will grow in years to come. I would like to highlight a few of these here.

The All India Coordinated Research Projects of the Indian Council of Agricultural Research operated at MACS-ARI have led to the development of twelve varieties each of wheat and soybean and one variety of grapes. These contributions have boosted crop production in our country. I congratulate the MACS-ARI team who have developed the wheat variety MACS 4058, which is biofortified with higher protein (14.7%), zinc

(37.8 ppm), iron (39.5 ppm), content as compared to the other popular varieties. MACS 4058 has figured among the seventeen biofortified crop varieties dedicated to the nation on World Food Day by the Honourable Prime Minister.

MACS-ARI research on grapes has led to the release and notification of grape variety ARI 516 by the Central Variety Release Committee, Government of India, for cultivation in Maharashtra, Punjab, Telangana, and Tamil Nadu. It is the first grape variety notified under the All India Coordinated Research Programme (Fruit). It is a multipurpose variety that can be used as table grapes or processed into raisins or juice.

Our scientists have come up with an efficient process for the biological route to production of Hydrogen from rice straw to meet the rising demands of green fuel. They have developed a consortium of bacteria and tested its ability to degrade rice straw to produce Hydrogen. To scale up the process for industrial scale deployment, a joint collaborative effort between MACS-ARI and Sentient Labs of KPIT Technologies Ltd. is being pursued. Microbial production of Hydrogen from agro-waste is expected to reduce pollution (caused by the burning of rice straw) and facilitate the sustainable production of green Hydrogen, a non-polluting source of fuel.

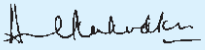
A noteworthy finding by our scientists working in nano bioscience is the development of a hemostatic xerogel dressing that will halt uncontrolled bleeding and prevent disability and fatality.

Documentation and conservation of the biodiversity of our diversity-rich nation is a significant challenge. Our scientists have reported several novel microbes, yeasts, fungi, lichens, diatoms, grasses, and higher plants. They have also compiled several medicinal applications of plants and lichens in the form of books. Our scientists have also adopted a cell culture-based approach to conserving endangered plant species.

The Covid-19 pandemic has posed a difficult situation for all of us. I am very happy that MACS – ARI has made very substantial contribution to war on Covid – 19. Laboratories for testing of Covid-19 samples had to be developed in large numbers throughout the country. MACS-ARI rose to the challenge and set up the SARS-CoV-2 testing laboratory that was duly recognized by the Indian Council of Medical Research (ICMR). More than 40,000 samples have been tested in this facility to date.

Before I conclude, I would like to place my appreciation of MACS-ARI staff for contributing to new knowledge in areas of its research and coming up with solutions to various needs of society. Similarly, I would like to thank all the life members of MACS for their support and guidance to the MACS-ARI staff and scientists.

I once again sincerely acknowledge the continuing support of the Department of Science & Technology, Government of India.



Anil Kakodkar
22 September 2021

Executive Summary

Dr PK Dhakephalkar
Director
Agharkar Research Institute
Pune

Welcome to the MACS-Agharkar Research Institute, an autonomous institute of DST, committed to the highest standards in research in life sciences for societal welfare for the past 75 years. It gives me immense pleasure to present the Annual Report for the year 2020-21.

We are committed to being a leading research institute by delivering the processes, technologies, and products that cater to the need of the society. Since our inception in 1946, we have progressed by leaps and bounds to become a nationally and internationally recognized research centre of excellence. We have succeeded in building a strong research facility.

Our scientists have contributed towards building MACS-ARI as a brand. Their discoveries have been published in journals of high international repute and impact. Many of our scientists have won awards and recognitions in their respective fields. Even during the Covid-19 pandemic, our researchers became sought-after speakers at national and international conferences, workshops, and other forums. I believe awards and recognitions do not necessarily make all the difference. How we apply our research to the societal benefit and to improve the life quality of a common citizen is all that really matters.

Multi-disciplinary collaborative efforts that resulted in the development of disease-resistant, drought-tolerant, low pesticide and low fertilizer requiring, high yielding, bio-fortified wheat variety is one such shining example of our contribution to the benefit of society. The development of microbial processes for the sustainable and environment-friendly production of fuel gases such as hydrogen and methane from agricultural waste is another such example. These examples show how we collectively put our efforts together and give our best for the welfare of our nation.

Last year, we launched our SARS-CoV-2 testing facility. We have tested more than 40,000 samples to date with minimum or no financial burden on our umbrella body,

DST. A great deal of dedication and contribution of our scientists and technical staff has only made the operation of the SARS-CoV-2 testing facility possible. We believe in sharing and have always provided our analytical and diagnostic and research infrastructure to facilitate industrial and academic research.

Our team of excellent researchers has published high-impact papers, filed patent applications, transferred technologies, developed improved crop varieties, trained students, developed skilled human resources, established state-of-the-art infrastructure, and disseminated knowledge in the society. We could not have achieved so much without the generosity of funding agencies such as the Department of Science and Technology, Indian Council of Agricultural Research, SERB, DBT, and industry partners, ONGC, KPIT Technologies Ltd., HTBSIL, etc. They have all readily rallied to enhance our cause.

We look forward to continuing to serve the nation, collaborating with industry and academia, and work for the benefit of the society.

PK Dhakephalkar
20 September 2021

ICMR approved COVID-19 testing laboratory

In response to the call from Department of Science and Technology to start a Covid-19 testing laboratory, approvals were obtained from the Institutional Biosafety committee (IBSC). National Centre for Cell Science, Pune helped in training scientists Dr JM Rajwade and Dr YA Karpe. A team from the Armed Forces Medical College, Pune reviewed the expertise. Indian Council of Medical Research approved the Covid-19 laboratory and testing began on 7 July 2020. Thirty staff members volunteered for the activity. Beginning with sixty samples per day we analyzed close to 20,000 samples up to March 2021.

As of now the average number of samples analysed in a day is nearly 115 and till date we have analyzed close to 35,000 samples. Initially samples were received from Civil Hospitals in Satara, Karad and Solapur. Currently we are analyzing samples from suburbs of Pune.

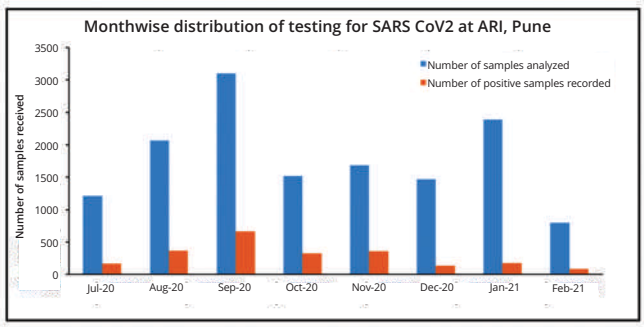
Rotary Club of Pune Central provided us with kits initially and we tested over 100 samples of healthcare workers free-of-cost. We have now added a new RT-PCR machine (Quant Studio 5.0) and automated system for nucleic acid extraction (King Flex, Thermo Fischer scientific) and other small equipment to our Molecular Diagnostic laboratory.

Initially the activity was financially supported by DST, and presently partial support is received from Directorate of Medical Education and Research, Government of Maharashtra.

Covid-19 activities
Agharkar Research Institute

COVID-19 testing

ARI has developed a state of the art facility for the PCR-based testing of COVID-19 (detection of SARS-CoV-2). The testing facility is operated strictly as per the ICMR guidelines. ARI staff scientists received training at another ICMR recognized facility at NCCS. Almost 15,000 samples have been tested at this state of the art facility comprising sophisticated equipment and renowned experts.

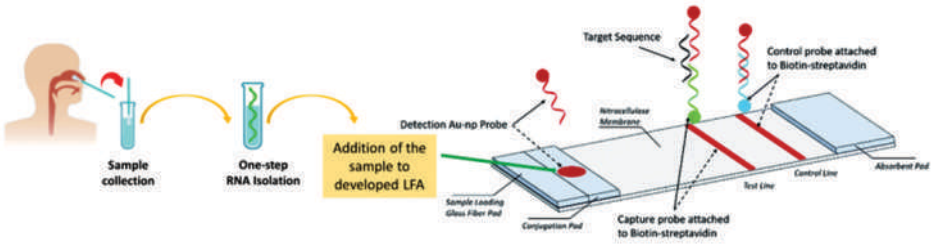


Samples were received from primary healthcare and COVIDcare centers from Satara district during July – December 2020. From Jan 2021, ARI is analyzing samples received from Pune region (Wagholi, Mulshi, Khadakvasala, Dehuroad). Expansion the facility is planned.

Kit to detect SARS-CoV-2

A team of ARI scientists has developed an economical, paper-based test kit to detect SARS-CoV-2. The kit is developed for the rapid detection of SARS-CoV-2 even by the unskilled personnel. This rapid colorimetric lateral flow assay qualitatively detects SARS-CoV-2 within ten minutes. The kit is developed as a part of DST-SERB sponsored project under special call for proposal for community screening of Covid-19 in India. Validation of the kit is underway at present.

10-minute paper-based test kit to detect SARS-CoV-2



Efforts of ARI scientists towards the development of a rapid diagnostic for detection of SARS-CoV-2

Donation of sanitizer

ARI scientists and staff distributed thousands of bottles of sanitizers to Pune Police during 'Lockdown-I' and 'Lockdown-II'. This exercise was undertaken to fulfill our social responsibility. The alcohol based sanitizer was prepared by ARI scientists and staff as per WHO standard formula.

Control measures at ARI agriculture farm

The ICAR All India Coordinated Research Projects on wheat, soybean, and grape are operated at ARI farm. The farming activity was continued even during the lock-down period. Social distancing norms were strictly followed. All labourers were trained to follow social distancing and clean hygiene. A roster was maintained for the farm staff and a minimum number of contract unskilled and semiskilled laborers were allowed to work under strict supervision of the farm staff. Safety instructions were displayed on the notice board. To avoid gathering, work was bifurcated in different plots and social distancing of two meters was followed. Use of face mask and sanitizer was compulsory. Drinking water breaks and lunch hours were staggered. As the contact labourersare dependent on daily wages for their livelihood, we supported them by providing work and wages in this crucial stage. ASHA workers in the region also visited the farm and received training/ instructions regarding the measures to contain COVID-19. Grampanchayat, Sortewadi, Baramati taluka, sanitized the farm campus.

ARI Scientists

Biodiversity and Palaeobiology Group


Dr Sanjay K Singh


Dr Bhaskar C Behera


Dr Kantimati G Kulkarni


Dr Paras Nath Singh


Dr Ritesh K Choudhary


Dr Karthick Balasubramanian


Dr Rajesh Kumar KC


Dr Abhishek Baghela


Dr Mandar N Datar


Dr Tushar Kaushik

Bioenergy Group


Dr Prashant K Dhakephalkar


Dr Monali C Rahalkar


Dr Sumit S Dagar


Mr Pranav R Kshirsagar

Bioprospecting Group

Dr Prasad P Kulkarni

Dr Pratibha Srivastava

Developmental Biology Group

Dr Surendra M Ghaskadbi

Dr Anuradha Ratnaparkhi

Dr Sachin H Jadhav

Dr Chinmoy Patra

Dr Bhupendra V Shravage

Genetics and Plant Breeding Group

Dr Shubhada A Tamhankar

Dr Manoj D Oak

Dr Sujata P Tetali

Dr Philips Varghese

Dr Ravindra M Patil

Mr Santosh A Jaybhay

Mr Ajit M Chavan

Dr Yashvanthakumar KJ

Dr VS Baviskar

Dr Sudhir Navathe

Nanobioscience Group

Dr Jyutika M Rajwade

Dr Dhananjay S Bodas

Dr Vandana Ghormade

Dr Virendra A Gajbhiye

Dr Yogesh A Karpe

Biodiversity and Palaeobiology

Studies in biodiversity and palaeobiology range from viruses, archaea, bacteria, fungi, lichens, diatoms, plants to fossil forms.

Biodiversity

Bacteria and Archaea

A novel Type I methanotroph *Methylolobus aquaticus* (novel genus and species) isolated from a tropical wetland

A novel gammaproteobacterial methanotroph; strain FWC3 was isolated from a tropical freshwater wetland sample collected near a beach in Western India. Strain FWC3 forms flesh pink/peach-colored colonies, is non-motile, and the cells are present as diplococci, triads, tetracocci and aggregates. As the 16S rRNA gene of strain FWC3 showed low similarities with other Type I methanotrophs (less than 94.3%), it was further investigated for its novelty and characterisation by a polyphasic approach. ANI indices and DDH values deduced from the draft genome of strain FWC3 (SEYW00000000.1) with the other nearest type strains *Methylocaldum marinum* S8^{T} and *Methylococcus capsulatus* Bath^{T}) were ~70% and ~15%, respectively. The low-level similarities indicated that strain FWC3 can belong to a new genus and species. Additionally, FWC3 showed a unique fatty acid profile with the dominance of C16:1 ω7 and ω6c, C16:0 and C16:1 ω9c. We proposed strain FWC3 to be the type strain of a novel genus and species for which the name *Methylolobus aquaticus* was suggested. The salient features of *Methylolobus aquaticus* included: obligate methanotrophy (can utilise only methane or methanol as the sole source of C and energy). Gram stain negative, nonmotile coccoid to oval cells which reproduce by binary fission and occur singly, in pairs, triads, tetracocci or aggregates. The cells use pMMO for methane oxidation. Gram-stain negative, aerobic, non-motile. Divides by binary fission. Can grow under neutral or a broader pH range. Mesophilic, some strains are psychrotolerant. Belongs to the family *Methylococcaceae*. Nitrogenase genes are present. The type strain of the novel species, *Methylolobus aquaticus* strain FWC3^{T} (= JCM 33786^{T} = KCTC 72733^{T}= MCC 4198^{T} was described in a publication in July 2020. The genome is available under the accession number SEYW00000000.1 in Genbank. It is the second new genus of methanotrophs described from India, and probably the first new methanotroph isolated from tropical wetland habitats. The metagenome analysis of two rice field samples from Western India and other parts of the world indicated that *Methylolobus* genus can be a prominent Type I methanotroph in such habitats and represents the yet uncultured group of Type I methanotrophs.

Genomic insights into three putatively novel species of *Butyrivibrio* from buffalo rumen

One cellulose-degrading strain CB08 and two xylan-degrading strains XB500-5 and X503 were isolated from buffalo rumen. All the strains were defined as putative novel species of *Butyrivibrio* based on phylogeny,

phylogenomy, digital DNA-DNA hybridization, and average nucleotide & amino acid identities with their closest type strains. The draft genome length of CB08 was ~3.54 Mb, while X503 and XB500-5 genome sizes were ~3.24 Mb and ~3.27 Mb, respectively. The cellulose and xylan degrading abilities and the presence of genes encoding diverse carbohydrate-active enzymes exhibited the lignocellulolytic potential of these strains. Further, the genome annotations revealed the metabolic pathways for monosaccharide fermentation to acetate, butyrate, lactate, ethanol, and hydrogen. The presence of complete hydrogenase gene cluster *hypABCDEF* in all three strains was observed for the first time in *Butyrivibrio*. Moreover, the presence of genes for chemotaxis, antibiotic resistance, antimicrobial activity, synthesis of vitamins, and essential fatty acid suggested the versatile metabolic nature of these *Butyrivibrio* strains in the rumen environment.

Taxonomic and genomic insights into a novel crude oil degrading bacteria *Xylanimonas oleitrophica* sp. nov. PW21T

Crude oil degrading bacteria PW21 was isolated from oil-contaminated sites of Gujarat, India. Based on 16S rRNA gene sequence analysis, the closest phylogenetic affiliate of PW21 was identified as *Xylanimonas allomyrinae* 2JSPR-7^T with 97.01% similarity. Also, PW21 shared sequence similarity of 96.44 % with *Isoptericola cucumis* AP 38^T, 96.80% with *Xylanimonas cellulosilytica* DSM 15894^T and 96.92% with *Isoptericola dokdonensis* DS-3^T. Phylogenetic affiliation on the basis of multigene analysis using housekeeping genes such as *gyrB* and *rpo*B further confirmed that PW21 shared maximum similarity of 88.14% and 85% respectively with *Xylanimonas cellulosilytica*. A phylogenetic tree based on the neighbour joining method revealed PW21 clusters with genus *Xylanimonas.* Whole genome sequencing of PW21 generated a draft genome of 3.49 Mbp consisting of 28 contigs. Its N50 value was 312426bp and with a coverage depth of 166X. The G+C content of PW21 calculated from the draft genome sequence was 73.8 %, comparable to the values given for members of the genus *Xylanimonas* (72.5-72.7 mol%). The ANI values between PW21 and the closely related *Xylanimonas* strains were lower than 95%, which is the proposed genomic species cut-off. Digital DNA-DNA hybridization and ANI values less than 70% and 95% respectively indicated the distinctness of PW21 with its closest phylogenetic affiliates. Annotation of the genome of PW21 revealed 51 tRNA; 3 other RNA; 3,108 proteins; 3,224 genes and 59 pseudogenes. A total of 3,290 coding sequences were identified, of which 1,128 were assigned to hypothetical proteins, while 2,162 were assigned to functional proteins.

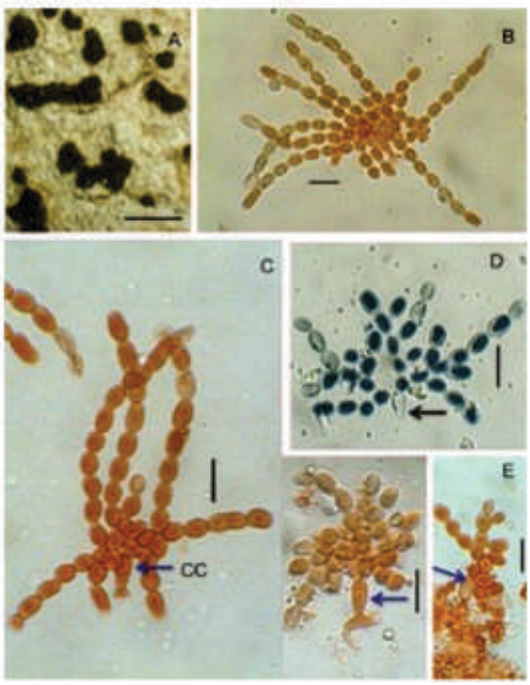
Based on 16S rRNA physiology, analysis of other housekeeping genes, DNA-DNA hydbridization and ANI value PW21 was considered as a novel species of genus *Xylanimonas*. It was assigned the name *Xylanimonas oleitrophica* sp. nov. PW21^T (o.le.i.tro'phi.ca. L. neut. n. *oleum*, oil; Gr. masc. adj. *trophikos*, feeding, nursing; N.L.fem. adj. *oleitrophica*, feeding on oil) as it was isolated from the oil-contaminated region. The 16S rRNA gene and the draft genome sequences of the strain PW21(KCTC 49338^T = JCM 33795^T = MCC 3936^T), are deposited in the GenBank/EMBL/DDBJ under the accession numbers MH458941 and NZ_QKWH01000001 respectively.

Fungi

Biodiversity, systematics, documentation and conservation of fungi & yeasts

Several filamentous and fungal yeast genera of different interesting taxonomic groups of fungi were studied. *In vitro* pure cultures were raised, and their taxonomic identity was confirmed based on morphological and molecular multigene phylogenetic analysis. These are as follows: *Aspergillus, Agaricus, Apioperdon, Ascobolus, Botryosporium, Botrytis, Calvatia, Chalara, Coleosporium, Colletotrichum, Cyathus, Daldinia, Deconica, Fusarium, Fusicolla, Glischroderma, Glomerella, Gonatophragmium, Lambertella, Marasmius, Nodulisporium, Oidium, Pallidocercospora, Periconia, Phaeoisariopsis, Phialophora, Phyllachora, Pleurotus, Protomyces, Puccinia, Saccharomyces, Saprolegnia, Scleroderma, Stemphylium, Termitomyces, Valsa.*

Novel genera *Brykendrickia catenata* (Gen. et sp. nov.) (Figure 1) and *Pedrocrousiella pongamiae* (Gen. et comb. Nov.) (Figure 2), and novel species *Cyathus uniperidiolus, Phaeoisaria synnematicus*, *Pseudocercospora crotolarigena* and a new record of *Gonatophragmium triunae,* were identified. Documentation of these fungi were completed and their germplasm are deposited in National Fungal Culture Collection of India (NFCCI). The novel taxa have been published in referred journals.



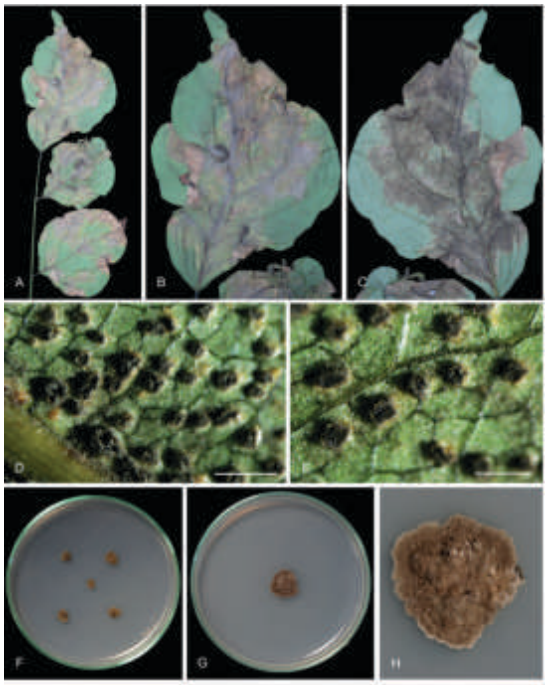


Figure 1 *Brykendrickia catenata* (holotype, PAN 32735). A. Sporodochia on natural substratum; B–E. Conidia with conidiogenous cell (arrows showing basal cell). Scale bars: A = 1000 µm; B–E = 10 µm

Figure 2 *Pedrocrousiella pongamiae* (AMH 10302 – epitype). A–C. Symptoms on the upper and lower surface of the host leaves, Pongamia pinnata. D, E. Sporodochial development on abaxial surface. F. Colonies on MEA after 15 d. G, H. Colonies on MEA after 45 d. Scale bars = 500 µm

A checklist of the genera of Coelomycetes, including genera of lichen forming, sexual morphs and synasexual morphs with coelomycetous morphs (genera A–C) was published. We have compiled all published generic names of coelomycetous taxa including invalid and illegitimate names. Further, sexual genera which have coelomycetous asexual morphs are also provided.

Screening of fungi for phosphate solubilization

Fungi are found to be more efficient in phosphate solubilization ability. This potential can be utilized in increasing the fertility of soil and in enhancing the yield of crop plants. Several isolates were screened for phosphate solubilizing ability. The isolates of three important genera like *Aspergillus*, *Penicillium* and *Cladosporium* were found to possess promising phosphate solubilization ability. *Aspergillus niger* showed most efficient activity with a solubilization index of 2.18. The results of this study showed that fungi showing positive activity can be useful as eco-friendly biofertilizers in agriculture to improve the soil health and crop productivity (Figure 3).

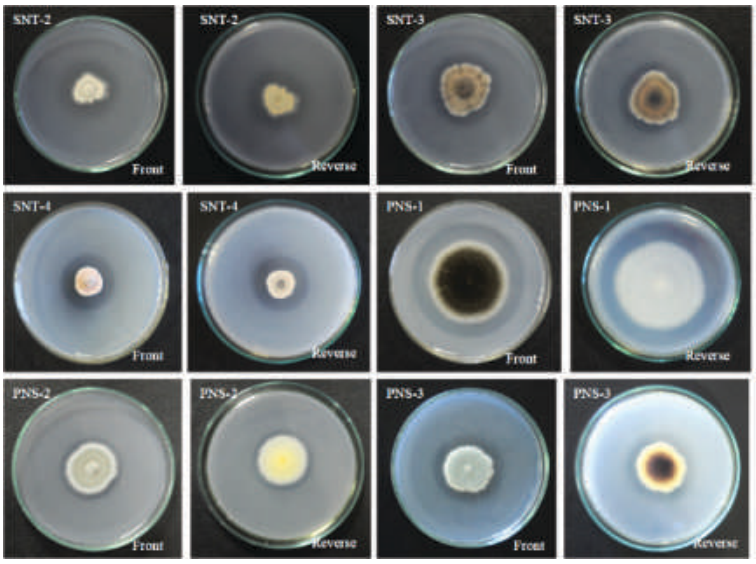


Figure 3

The *Aspergillus* and *Penicillium* spp. showing phosphate solubilizing ability (clear hallow zone around the colonies)

Studies on yeast diversity, taxonomy and applications

A novel yeast species *Suhomyces drosophilae* was isolated from *Drosophila* flies feeding on a stinkhorn mushroom, and published. We have isolated and characterized gut associated yeasts from different species of termites from India. Many of these yeasts were found to possess xylanolytic activity and produced high amount of ethanol from lignocellulosic biomass. While working on yeast diversity in a traditional Goan fermented food bollo batter, we established *Saccharomyces cerevisiae* DABRP5 as a potential probiotic strain. We have also discovered a remarkable inter-specific CAT fusion between two important plant fungal pathogens *Colletotrichum gloeosporioides* and *C. siamense* and attributed this process as an alternative mechanism for generation of genetic diversity in these fungi.

Natural product chemistry

Fungi synthesize a variety of secondary metabolites which are often structurally unique. Secondary compounds from fungi are used for in human and animal welfare. Recently, much attention has been paid on the biological role of bioactive fungal secondary metabolites, such as antibacterial, antifungal, antiviral, antioxidant, antitumor, anti-inflammatory, cardiovascular-protective, neuroprotective, α- and β- glucosidase and prolyl endopeptidase inhibitory activities etc.

Beauvericin (BEA) is a potent compound and exhibits anticancer, cytotoxic, antiplatelet aggregation, antimicrobial, leishmanicidal and insecticidal activities. These activities are mainly due to its ionophoric properties that disrupt the normal physiological concentration of cations. BEA has been reported to get accumulated in the tumor tissues to significantly increase necrotic areas within the tumor, thus confirming its promising role as a novel natural compound for its use in cancer. It was first reported from *Beauveria bassiana*, an entomogenous fungus, but later found to be produced from other fungal genera like *Fusarium*, *Isaria* and *Paecilomyces*. More than 100 isolates of *Fusarium* have been identified on the basis of cultural characterstics and multigene phylogeny were found producing beauvericin. The productivity yield ranged from 0.05 to 185 mg/ litre of the media. Nearly, 50 % of the screened isolates were capable of producing very low to significant amount of beauvericin.

Similarly, fungi known to produce colors/ pigments are being studied for their application in textile industry. We have found that cotton fabrics are dyed successfully using crude pigment. Pigment uptake was observed

better in cotton fabric mordanted with $FeSO_4$ compared to alum. Based on these encouraging results further separation of pigment components was done by high performance thin layer chromatography (HP-TLC). Chemical characterization of purified orange compound was done by UV-VIS spectroscopy and λmax value for the purified pigment was recorded. Purity of the pigment was checked and confirmed by High Performance Liquid Chromatography (HPLC, Waters) using Acetonitrile and water (85:15) as mobile phase.

Lichens

Lichens were collected from various altitudes at Medha Ghat, Gureghar and its nearby forest areas of the Western Ghats. Here members of family Parmeliaceae, Collemataceae, Physciaceae, Graphidaceae etc. grow luxuriantly. Close to sixty lichen samples were collected and segregated into groups depending upon their growth forms, genus and family. They were deposited and accessioned in Ajrekar Mycological Herbarium (AMH) (Figure 4).

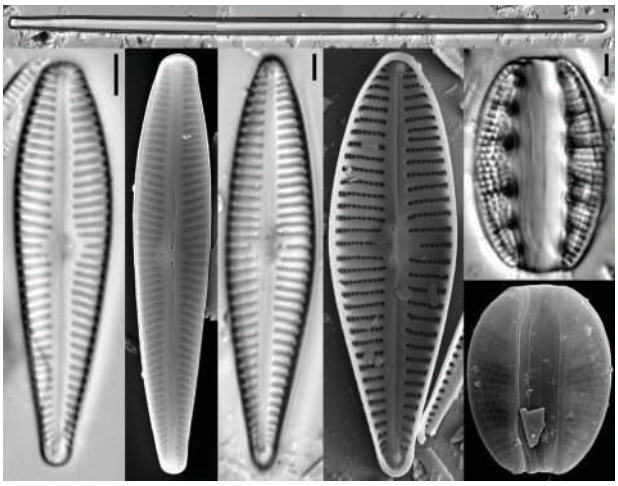
Figure 4

A. *Parmotrema reticulatum*, B. *Parmotrema tinctorun*, C. *Heterodermia diademata*, D. *Cetrelia pseudoolivetorum*, E. *Heterodermia hypocaesia*, F. *Everniastum cirrhatum*, G. *Flavopunctelia flaventior*, H. *Flavoparmelia caperata*, I. *Cladonia furcata*, J. *Stereocaulon foliolosum*, K. *Nephromopsis laii*, L. *Heterodermia boryi*

Plants & Diatoms

Discovery and revision of diatom flora of the Western Ghats

Diatoms are a unique group of diverse microalgae. It is estimated that more than two lakh species of microalgae exist the world over, of which 75,000 taxa have been recorded. Diatom communities of the Indian subcontinent are poorly investigated. We are studying the diatom diversity of the three freshwater biogeographic regions of Peninsular India.



We have found four new species of diatoms from the streams and rivers of the Western Ghats, viz. *Tabularia koynensis* Vigneshwaran, D.M.Williams & Karthick, *Gomphonema kallarense* Pardhi, Vigneshwaran, Kociolek, Glushchenko, Kulikovskiy & Karthick, *Gomphonema kezlyae* Pardhi, Vigneshwaran, Kociolek, Glushchenko, Kulikovskiy & Karthick, and *Epithemia agharkarii* A. Vigneshwaran, J.P. Kociolek & B. Karthick (Figure 5).

Figure 5

Plate showing new species of diatoms described from the Western Ghats. Scale bar = 2 micron

Out of these, three taxa are exclusively to the Western Ghats region. Subsequently, we have found *Gomphonema kezlyae* in Vietnam, Southeast Asia. This observation confirms that India and Vietnam share some species in common, providing additional evidence for the biogeography of freshwater diatoms from the tropics. We also corrected some of the taxonomic and nomenclatural problems of previously described diatoms by Hemendrakumar Prithivraj Gandhi (1920-2008), who pioneered studies on Indian diatoms. We validated around 50 taxa described by HP Gandhi.

Description and phylogenetic position of three new species of Stauroneis Ehrenberg (Bacillariophyceae: Stauroneidaceae) from the Indian Subcontinent

Stauroneis Ehrenberg is a species-rich genus that is common and widespread having a worldwide distribution and comprises more than 600 species and intraspecific taxa with some variation in cell morphology. Recently, studies have explored the molecular diversity of *Stauroneis* from the temperate region, but there is no molecular data for tropical species. In the present study, four species of *Stauroneis* were investigated using morphological and molecular data. Morphological characters were analysed using light microscopy (LM) and scanning electron microscopy (SEM), and the features of each taxon were compared with similar species within the genus. For the molecular analyses, *Stauroneis* strains were isolated, cultured, DNA was extracted, and sequences from *rbc*L and 18S genes were analysed to determine phylogenetic relationships. Our analysis describes three new species and records one previously known species. The new species are: (1) *Stauroneis lateritica* Wadmare, Kociolek & B. Karthick, characterized by small frustules with elliptical lanceolate valves and short subrostrate apices, broad central bow-tie shaped stauros, and few moderate striae centrally becoming strongly radiate towards the poles; (2) *Stauroneis sholaii* Wadmare, Kociolek & B. Karthick, which has broad lanceolate valves with short rectangular stauros and radiate striae; and (3) *Stauroneis bartii* Wadmare, Kociolek & B. Karthick, which has large, lanceolate valves with rounded apices, a stauros with 4–7 shortened striae and radiate striae. Ultrastructure and molecular data from India for the previously known, widespread species *Stauroneis gracilis* Ehrenberg are presented. The combined morphological and molecular approach supports recognition of *S. lateritica*, *S. sholaii* and *S. bartii* as new species. This study is the first-ever attempt at molecular species discovery of diatoms from the Indian subcontinent.

A survey of diatom assemblages and diversity from Northeast India

The documentation of diatoms from northeast India (a part of the Eastern Himalayas and Indo-Burma biodiversity hotspot region) focuses on understanding the diatom diversity and habitat specificity. We have collected samples from aquatic and semi-aquatic habitats across all states of northeast India. A total of 688 samples were collected from various habitats across elevational gradients ranging from 50-5200 m above sea level. Additionally, we have collected water samples to analyze the water chemistry for preparing a relational database between the diatom composition and water quality. Till date we have enumerated 37 aquatic and 32 aerophilic samples for diatom analysis and documented ~400 and ~200 taxa respectively and analysed ion concentration for 90 water samples. The rarefaction curves produced by the aquatic and aerophilic samples are not converged and still increasing, signifying that we have not yet observed all the taxa present. Species found to occur commonly in northeast India are *Achnanthidium, Gomphonema, Nitzschia, Encyonema, Eunotia, Navicula, Adlafia, Sellaphora, Planothidium, Ulnaria* and *Humidophila* of which many were discovered as putative novel taxa. While documenting the taxa, we have discovered four novel taxa *Pinnularia sikkimensis* S.K.Das, C.Radhakrishnan, Kociolek & B.Karthick*; Encyonema keshrii* S.Roy, C.Radhakrishnan, J.C.Taylor, Kulikovskiy & B.Karthick*; Gomphonema adhikarii* S.K.Das, Kociolek & B.Karthick and *Diploneis mawsmaii* Bhatt & B.Karthick. Moreover, we are working towards describing four more new species belonging to the genus

Humidophila, Rhoicosphenia and *Ulnaria.* Thirty diatom monocultures were established from the samples collected from the northeast covering genera *Stauroneis*, *Craticula*, *Nitzschia*, *Hantzschia* and *Navicula*.

Tree moss diatoms from Indo-Burma biodiversity hotspot of India

In the diatom ecology, aquatic habitats have been explored but aerial habitats are meagerly studied. We are studying aerial diatoms on the semi-aquatic habitats from one of the biodiversity hotspots of the Indo-Burma region. Blue Mountain is one of the highest peaks in this region, with an elevation of around 2157 m a.s.l. In this study, we have collected 22 tree moss samples across the altitudinal gradients and documented 21 genera of diatoms. The diatom species richness recorded a minimum of 8 to a maximum of 22 per moss sample. The most dominant taxa are *Orthoseira roeseana*, *Luticola* sp.2, and *Eunotia* sp.2. Further, there are also many species belonging to genera *Nupela*, *Humidophila*, *Eunotia,* and *Stauroneis*, which are new to science and yet to be described. Beta diversity analysis explained the high species turnover, which indicates the uniqueness of the species. The taxa recorded from these tree moss habitats are not found in the nearby aquatic environment such as rivers and streams, demonstrating that these taxa are specific to aerial habitat. Thus, our results indicate that aerial habitats have their own ecological conditions which drive their diatom diversity.

Identifying the narrow pockets of endemism in biodiversity hotspots of the Western Ghats using eukaryotic microorganisms

It has been claimed for a long time that microbial taxa do not exhibit endemism, which is strongly supported by the Baas Becking hypothesis that "Everything is Everywhere, but the environment selects" (EiE) concept. There is a strong, long-standing belief that because of their strong dispersal capacity, microbial taxa are ubiquitous and show a very weak diversity gradient. We used diatoms to understand this concept of microbial biogeography. The present study was focused on the Western Ghats, which is amongst the 34 global biodiversity hotspots and home to a very special kind of ecosystem such as *Myristica* swamps. The aim of the study was to assess the diversity and distribution of diatom assemblages across the environmental gradients from the isolated ecosystems of *Myristica* swamps and the adjacent aquatic habitats outside the swamps and; to compare the endemism of the diatom species inside the swamp and adjacent aquatic ecosystem.

We collected the diatom samples along with all environmental variables across 14 swamps and adjacent aquatic habitats. Analysis and identification of samples revealed the following: (1) 117 diatom taxa were found from *Myristica swamps* and adjacent aquatic habitats, of which 75 occurred in swamps, 17 in adjacent aquatic habitats and 21 were common to both the habitats. (2) The dominant diatom taxa in the swamps are *Eunotia rhomboidea*, *Brachysira microcephala*, *Navicula obtecta*, *Frustulia crassinervia*, and many new species from genera *Navicula*, *Neidium*, and *Frustulia,* which are rare and specific to acidic environmental conditions. (3) The dominant diatom taxa in the streams are *Achnanthidium minutissimum*, *Achnanthidium initium*, *Gomphonema parvulum*, *Navicula cryptocephala*, *Nitzschia palea*, etc. Most of these are widespread cosmopolitan taxa. (4) Despite the same latitudinal range (13.5°-14.6°), the swamp harbours a high percentage of endemism compared to the adjacent river and stream areas. We have concluded that from the 96 total documented diatom taxa, 54 taxa are 'endemic' to the unique acidic conditions of the *Myristica* swamps and are putative novel species, proving that microorganisms too exhibit regional and point endemism.

Diatom Collection

The diatom collection at Agharkar Research Institute is South Asia's biggest diatom collection with samples and strewn slides. The collection holds around 3207 samples covering the present day to Pleistocene period from various parts of the country.

Revisiting the taxonomy of the wild relatives of *Sarsaparilla* (*Smilax* L.) in India, developing super-barcodes, and understanding their diversification using phylogenomic tools

The genus *Smilax* L. (Family: Smilacaceae) in India is represented by about 27 species, distributed mostly in the Himalayan region. They are popularly known as 'Sarsaparilla' and have tremendous scope to provide different therapeutic compounds as an anti-inflammatory, antifungal, antipruritic, antiseptic, diuretic, etc. (Figure 6). However, the identity of *Smilax* species is often difficult due to the dioecious nature of the plants, and the close morphological similarity of the species.

Figure 6 Fruits of *Smilax zeylanica* L.

Nonetheless, a complete taxonomic revision is hitherto not available for Indian Smilacaceae which creates a problem in the proper identification of the species. Earlier studies predicted that more than 40 % of the *Smilax* species could be treated as synonyms. Many of the species have restricted distribution, and it is difficult to meet their increasing demand from the crude drug market and, therefore, adulteration/substitution in the market samples is suspected. The proposal aims to develop DNA Super-barcodes for the selected *Smilax* species for their true identification/ delimitation. The study also intends to study the pattern of inter/ intraspecific morphological evolution in different Indian *Smilax* species and to decipher the phylogenetic relationship between them. Earlier studies have found Indian *Smilax* pivotal to connect the species in East Asia, Southeast Asia, and Africa. Therefore, studying phytogeography of the Himalayan *Smilax* could help in a better understanding of the temporal origins and biogeographic processes underlying the formation of disjunctive distribution patterns of the species. An attempt is being made to derive the phytogeography of *Smilax* across Indian Himalayas and understand the species' radiation pattern (spatial diversification and cladogenesis) in the Himalayas.

Against this background, the present work is being carried out with the explicit goal to (i) revise the taxonomy of Smilacaceae in India, (ii) understand the morphological evolution and diversification of the genus *Smilax* in the Himalayan region, and (iii) to develop DNA super-barcodes of the important Indian *Smilax* species using phylogenomic data.

Repository of Crude Drugs and Authentication Service

The project aims to maintain and enrich the repository of genuine/ authenticated crude drug specimens by voucher depositions of field/ market samples of crude drugs. The authentication service is being rendered to pharmaceuticals, researchers, and students, using relevant taxonomical and pharmacognostical literature and tools.

Understanding the morphological evolution and ecological diversification of the forest dwelling capers in Indian subcontinent using molecular phylogenetic tools

The genus *Capparis* is the largest genera of the family Capparaceae represented by 141 taxa. The genus is distributed in tropical and pan-tropical regions of the Old World. In India the genus is represented by total 35 taxa consisting 34 species and one subspecies. We revised the genus *Capparis* in India and published a book "The genus *Capparis* L. in India".

The book provides a detailed account on morphology, taxonomic description, taxonomic key, field and microscopic photographs, distribution maps, English or local names and economic and medicinal usage of each taxa found in India. *Capparis incanescens* DC., endemic to south India (Tamil Nadu) was reinstated. Selected nuclear and chloroplast regions were sequenced to decipher the phylogeny and biogeography of the genus. The analysis is in progress.

Muraina-grasses of India: Addressing the polymorphism and interspecific variation through morphological, ecological and molecular phylogenetic studies

Ischaemum L. is one of the dominant genera of tribe Andropogoneae and sub-tribe Ischaeminae. The genus is distributed throughout the Indian subcontinent. It is one of the highly endemic grass genera in India. Extensive studies of herbaria and literature helped us to organize excursion tours to collect *Ischaemum* species from different parts of India mostly in Western Ghats. A total of 355 accessions including 46 species were collected during this study. DNA extraction was performed for all collected species. Total of 28 sequences were submitted to NCBI. Critical screening and morphological studies of collected accessions revealed a novel species of *Ischaemum* from Satuli village near Amboli, Maharashtra. *Ischaemum amboliense* is the name proposed for the said novel species (Figure 7).

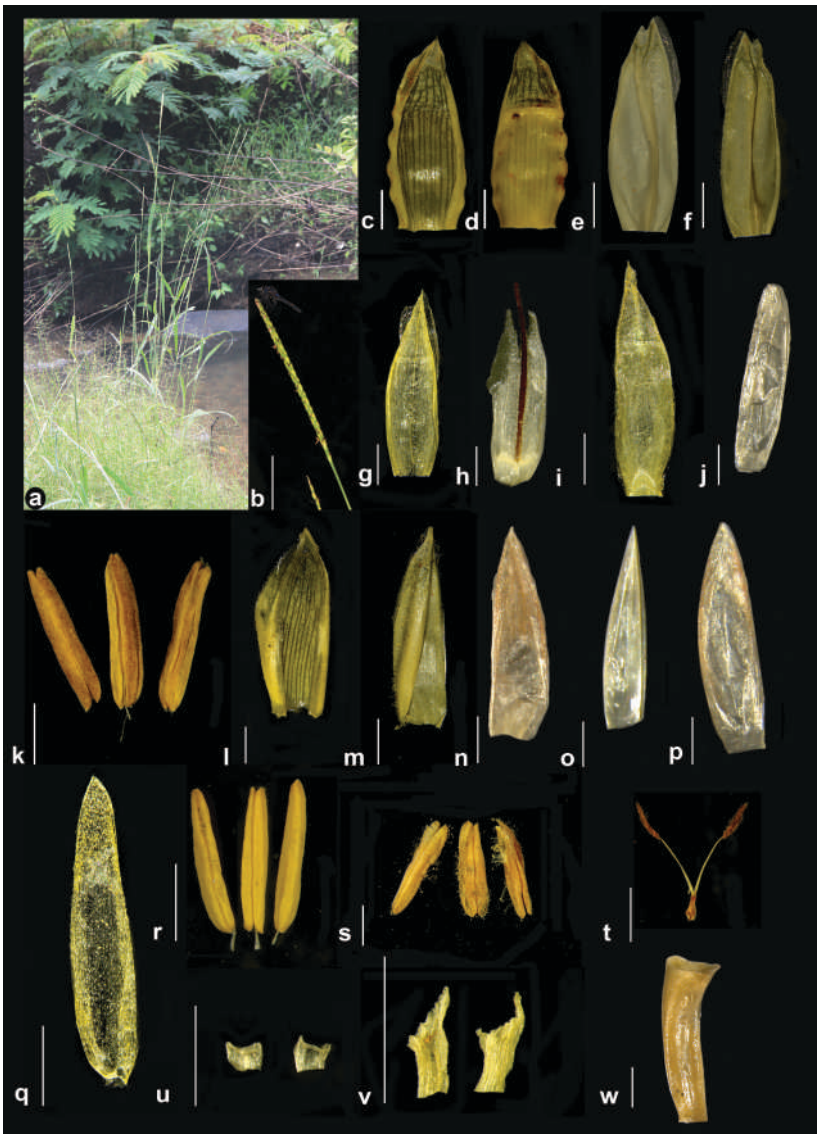


Figure 7

Ischaemum amboliense. a: habit, b: raceme, c–k: sessile spikelet, c: abaxial view of lower glume showing wing, d: adaxial view of lower glume showing side nodules, e & f: upper glume adaxial view, g: lower lemma, h: upper lemma, i: lower palea, j: upper palea, k: stamens of lower florets, l–v: pedicelled spikelets, l: lower glume, m: upper glume, n: lower lemma, o: upper lemma, p: lower palea, q: upper palea, r: stamens of lower florets, s: stamens of upper florets, t: carpel of upper florets, u: upper floret lodicules, v: lower floret lodicules. w: joint. Scale: b: 2 cm, c–w: 1 mm

Tree diversity and community structure of fragmented forests of Northern Western Ghats

The forests of Northern Western Ghats are distributed and fragmented owing to increasing anthropogenic activities. Though fragmented, they provide shelter to many endemic, rare, and medicinal species. To understand the impact of the fragmentation on species composition and community structure, we are surveying forests all along the Northern Western Ghats. Forty locations were surveyed, including forest patches from sacred groves, private forests, and legally protected areas. Altogether, we have recorded a total of 140 tree species which include evergreen 54 % and deciduous 46 % (Figure 8). In addition to correlating the species diversity and composition with various scales of disturbances at each location, we are also estimating carbon sequestered in these forest fragments.

Figure 8
Tree diversity from Northern Western Ghats

Conservation of selected endemic species of orchids of Northern Western Ghats through ex-situ multiplication and reintroduction in wild

As a part of conservation of selected endemic species of orchids of the Northern Western Ghats, successful asymbiotic seed germination of *Habenaria commelinifolia* (Roxb.) Wall. ex Lindl. and *Habenaria panchganiensis* Santapau & Kapadia is achieved through plant tissue culture technique. Standardization protocol for hardening and acclimatization of *in vitro* grown *Habenaria commelinifolia* plantlets was finalised. Almost 38% plantlets survived in controlled environmental conditions and are maintained in ARI polyhouse (Figure 9). These plantlets will be transferred to Tata Power Company at Lonavala for acclimatization and from there in to the wild habitat. *In vitro* established seedlings of *Habenaria panchganiensis* will be hardened after appropriate growth stage.

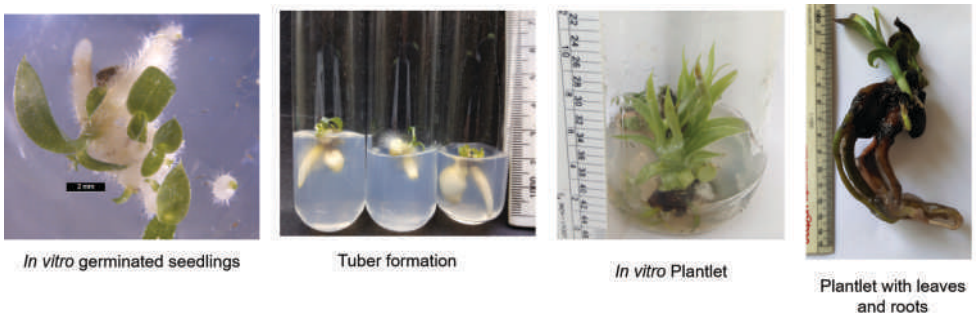


Figure 9
In vitro grown *Habenaria commelinifolia* plantlets

Palaeobiology

Ichnology and sedimentology

The hardgrounds identified within the Claystone Member exposed near Kuwapadar and in the Siltstone Member exposed SW of Vinjhan in the Kankavati River cliff section exhibit certain depositional characters. Both the hardgrounds represent minor cessations in sedimentation as revealed by the boring ichnotaxa, encrusting oysters and barnacles. Borings on both surfaces of large angular slabs of the hardground indicate in-situ breakage of the horizon and flipping of the same exposing the pristine surface to marine waters. As such they suggest deposition in a very shallow sea that experienced minor oscillations in sea level.

In a cliff section southwest of Vinjhan village is exposed a 1.0 m sandstone unit with symmetrical wave ripple marks passing in to linguoid ripple marks. On these ripple marks occur traces like *Ancorichnus*, *Gyrochorte*, *Rhizocorallium*, *Scolicia*, *Taenidium*, *Teichichnus*, slender vertical burrows as well as nondescript trails (Figure 10).

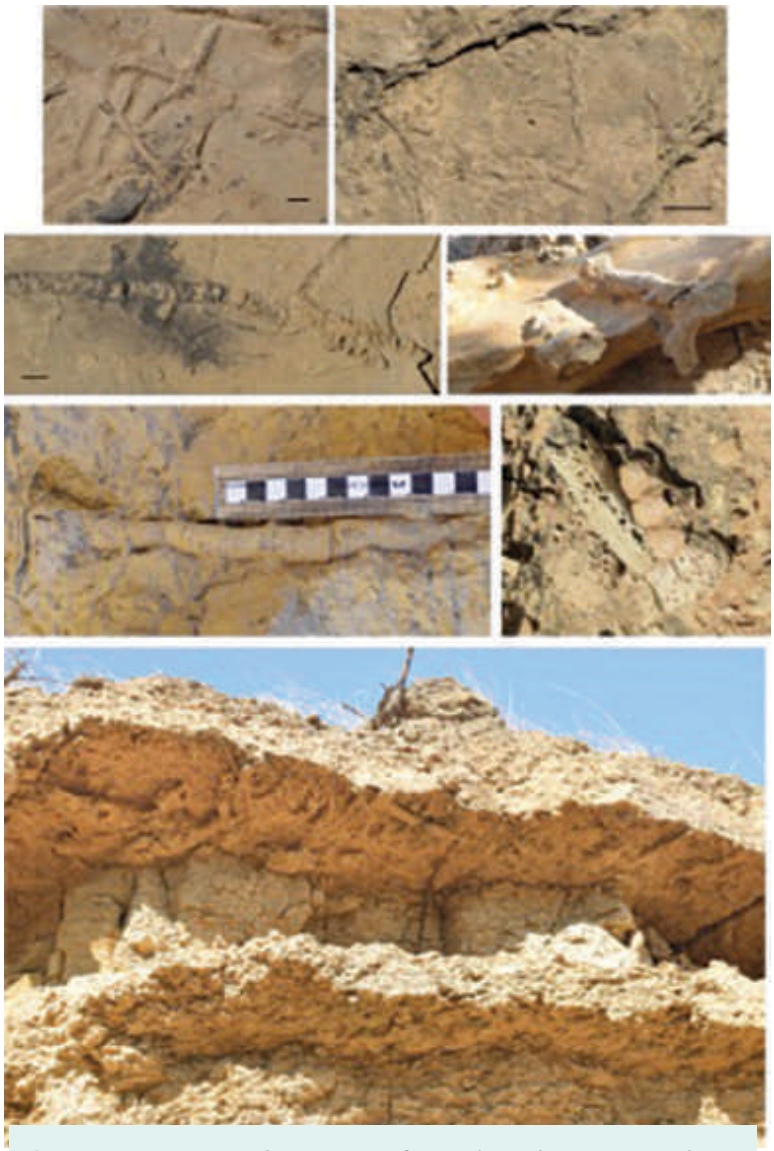
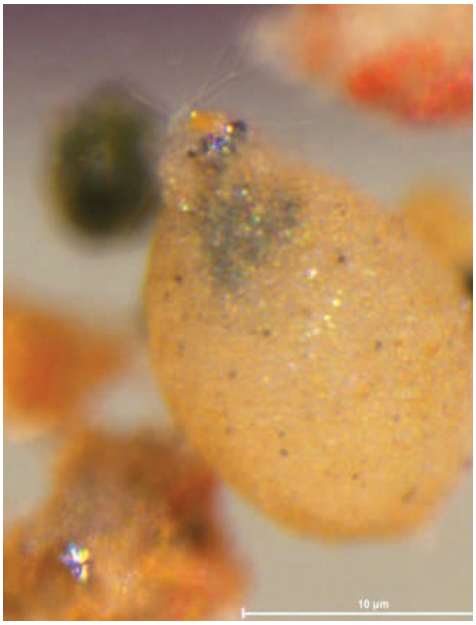


Figure 10 Various ichnogenera from the Siltstone Member, Chhasra Formation, Kankavati River cliff section southwest of Vinjhan village. Bar scale: 10 mm

A bivariate plot of SiO_2 against total Al_2O_3+Na_2O+K_2O, indicates deposition of sediments in semi-arid to arid climate, and chemical immaturity. According to the equation of Hayashi et al. (1997) [SiO_2 (wt. %) = 39.34 + 1.2578 (Al_2O_3/TiO_2) – 0.0109 (Al_2O_3/TiO_2)2], the average silica content of the source rock of these sediments is 55.79%, which matches with that of basalts (Hayashi et al., 1997). The sediments analysed show CIA (Chemical index of alteration) percentages that vary from 30.65% to 82.86% and average 58.66%. PIA (Plagioclase Index of Alteration) values vary from 29.07% to 94.71% and average 61.64%. The CIW (Chemical Index of Weathering) (31.85 to 95.51%) and CIW' (CIW modified for carbonate-bearing siliciclastic rocks) (48.31 to 97.71%) also show similar trends. The Al_2O_3 - (CaO + Na_2O) – K_2O ternary diagram of Nesbitt and Young (1984) as well as the (Al_2O3 + K_2O) - CaO*– Na_2O diagram by Nesbitt and Young (1982) imply weathering trends either from a basaltic or a granodioritic provenance respectively. The sediment samples studied plot within the rift field on discriminant function diagram of Verma and Armstrong-Altrin (2013), which is in accordance with the tectonic setting (Biswas, 2016) of Kachchh Basin.

First report of an organic walled benthic foraminifer from the Maharashtra coast

An important environmental bio-indicator benthic foraminifer *Psammophaga simplora* (Arnold, 1982), is reported for the first time from the recent intertidal sediments along the Rajapuri creek, Raigad district, Maharashtra (Figure 11).



This previously undiscovered organic walled foraminiferal species is found in abundance and constitutes nearly 20 % of the total foraminiferal population. The uniqueness of this particular foraminifer is its ability to ingest and concentrate mineral grains in its protoplasm. The nature of ingested mineral particles is yet unknown but it may provide clues about the elemental richness of ambient sediments in which this organism thrives. The discovery of this single-celled organic-walled monothalamous foraminifer from Indian coast, extends the known biogeographic range of genus *Psammophaga*, outside Pacific, Atlantic, and polar waters.

Figure 11
Living specimens of *Psammophaga simplora*

A new methodology towards improving bio-chronological framework for IODP/ODP deep sea sediment cores which lacks palaeomagnetic stratigraphy

From source to the sink, the detrital high-temperature Fe-Ti oxides are considered responsible for imparting the magnetic remanence in deep sea (pelagic) sediment. In the case of deep sea sediments which are distant from the source of terrigenous input, it shows poor concentration of these magnetic minerals and thus present a challenge in deriving magnetic information from deep sea cores extracted from such locations. The absence of palaeomagnetic stratigraphy presents a challenge in establishing geochronological time frame for such sections and assigning ages to recorded foraminiferal bio-events. Shaw's graphic correlation method (Shaw, 1964) is a statistical method that can be applied to indirectly calibrate a complete series of planktic foraminiferal bio-events recorded from a deep sea site lacking magnetic data. In this study we studied foraminiferal bio-events (first-occurrence and last-occurrence) from Ocean Drilling Program (ODP) Site 807A (western equatorial Pacific Ocean; present study) which lack paleomagnetic information and compared it with ODP Site 763A (southeastern Indian Ocean; Sinha & Singh, 2008), using Shaw's graphic correlation method. Here, we used a series of statistical interpolations between bio-events recorded at ODP 807A with the corresponding bio-events of ODP site 763A, having the advantage of available palaeomagnetic stratigraphy.

Bioenergy

Effect of microbial performance on enhanced oil recovery using core flood studies

To understand how reservoir properties, affect oil recovery will permit the prudent application of microorganisms for enhanced oil recovery. The core flooding studies mimicking the reservoir conditions were performed to evaluate the oil recovery potential of the developed hyper-thermophilic cultures.Core flooding experiments were carried out in the pressure tapped core holder (Figure 12).

Figure 12
Core flood set up: Control panel to monitor upstream, back and overburden pressure of the system and Incubator containing core holder to maintain incubation temperature

Berea sandstone (Figure13) of 6.9 cm length and 3.2 cm diameter was saturated with Light paraffinic oil from Gandhar oil well, Gujarat having API gravity of 42°.

Figure 13 Berea sandstone

Core flood experiments were conducted at 900psi and 96° to mimic the pressure and temperature of the oilfield, respectively. Oil recovery was performed after 21 days of incubation. Two developed hyper-thermophilic cultures designated as 101C5 and 101ShGGSII grown in optimized Molasses medium were used in the present study. 101C5 was identified as a putative novel species of *Thermococcus*, while 101ShGGSII as *Clostridium guangxiense*. 101C5 effected 29.5% and 101ShGGSII effected 14.6% additional oil recovery from Berea core. Higher oil recovery by 101C5 can be well attributed to the significant quantities of acetic acid (613.4 ppm), lactic acid (2814.5 ppm) as well as gases (H_2 and CO_2) generated by the culture, which may have acted on the paraffinic content of oil and reduced its viscosity, allowing it to display improved flow features and thereby, facilitating enhanced oil recovery. Suitability of 101C5 for MEOR application in sandstone like formations was further underscored by its smaller cell size of 0.3 mof 101C5 as compared to 1 mof 101ShGGSII, which made movement of 101C5 through small pores of sandstone easier.

To the best of our knowledge>29.5% recovery of the residual oil by MEOR is one of the highest ever reported efficiency of MEOR for any microorganisms at any temperature in core flood studies.

Biohydrogen production using termite gut microflora (TGM) from rice straw

Dependence on non-renewable sources of energy has led to rapid depletion of these sources. Thus, there is a need to develop alternative source of energy from renewable sources. Amongst renewable sources hydrogen as a biofuel has various advantages such as high calorific value and its combustion produces only heat and water. An efficient process for biohydrogen production from rice straw was studied in continuous mode. A specially developed consortium of bacteria from termite gut was tested for its ability to degrade rice straw to produce hydrogen via dark fermentation. Enrichment of microbial flora from the termite gut was done on basal salt media (BSM). This termite gut microflora (TGM) was assessed for its ability to degrade rice straw and produce biohydrogen. Microbial community associated with hydrogen production was studied by metagenome analysis of TGM. 16S Metagenome analysis revealed that Firmicutes was the most dominant phylum accounting for 98.86 % of the total population, followed by Proteobacteria (1.06%) and Actinobacteria (0.04%). At Genus level *Clostridium* was the most abundant genus accounting for about 97% of the total population. Abundance at species level identified *Clostridium guangxiense*at 12.53%*, Clostridium neuense*at 10.8% and *Clostridium beijerinckii* at 4.3% were the most significant OTU accounting for about 97% of the total population. Biohydrogen production at 1L scale was setup and under optimized conditions. The average yield in continuous mode was 43 ml g^{-1} TS. Thus, an economically viable and high yielding process of hydrogen production can be developed from rice straw.

SRB lytic bacteriophage mediated inhibition of SRB growth and H2S production

Sulfate-reducing bacteria (SRB), the discreditable microbes in the oil reservoirs, produce hydrogen sulfide (H_2S) as a part of the sulfate metabolism, which adversely affects the quality of crude oil. In addition, SRB indirectly damages iron construction by the corrosive H_2S gas. Annually, billions of dollars are spent on the control of SRB and SRB-mediated corrosion. However, the currently available treatments are chemically based and insufficient and ineffective against the targeted microbes. Thus, there is need to develop a method to specifically target SRB. Use of bacteriophages specific for SRB could be a suitable alternative to current treatment methods. Different water sample were screened for the presence of SRB-lytic bacteriophage. SRB-lytic bacteriophages were enriched and isolated using the plaque assay technique (Figure 14). Further the isolated bacteriophage was tested on a consortium of SRB at different SRB cell densities. The MPN data suggested the SRB count in the reservoir ranges from 10 to 10^4 cells/ml, therefore the efficacy of SRB-lytic bacteriophages was tested on these SRB cell densities; In single dosing experiments 70, 81, 88, and 91% reduction was observed in H_2S for initial cell density 10^4, 10^3, 10^2, and 10 cells/ml respectively. This inhibitory effect was observed upto 8 days. To obtain extended inhibition a repeated dosing of bacteriophage was performed at a regular time interim. Repeated dosing of SRB-lytic bacteriophage extends the inhibitory effect to >18 days. Thus, ARI has developed a bio-control process for inhibition of SRB which is effective, inexpensive, and environmentally benign process.

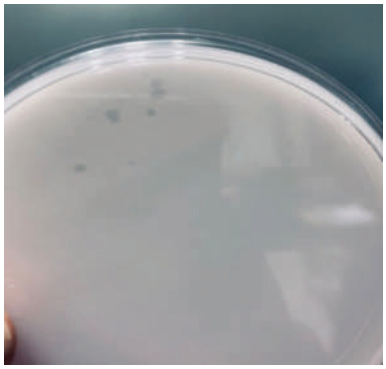


Figure 14
Plaques observed against *Desulfovibrio indonesiensis*

Development and demonstration of extraction of protein from Azolla biomass

Azolla biomass can rapidly colonize wetlands and attracting attention because of their ability to grow in wastewaters and produce large amounts of biomass. *Azolla has nutritional value and it isa rich source of minerals (10-15% of dry weight), essential amino acids (7-10% of dry weight), 20–30% of azolla's dry weight is protein, vitamins and carotenoids. Experiments were set up using Maharashtra and Tamilnadu region azolla biomass* (Figure 15). *Characterizations of azolla biomass revealed the presence of 21% (w/w) protein.* The parameters pH of the solvent (7-12), ratio of azolla biomass/ solvent (1:50-1:10), time of extraction(1h-5h) and temperature(35-95°C) were optimized. Validation experiments were set up under optimized parameters azolla biomass/ solvent ratio-1:10, temperature-95°C, time of extraction 1h, and pH of the solvent-7.0 revealed the protein yield was 18.45% and protein recovery was 88.81% on wet wt. basis. Inorganic fraction of crude protein was separated for detailed characterization. HPLC analysis revealed no degradation of recovered protein at higher temperature.

(a)

Tamilnadu (TN) region

Maharashtra (MH) region

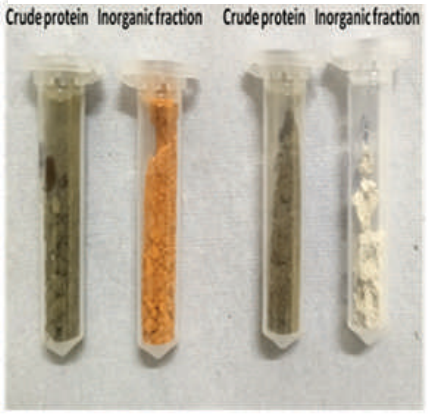
(b)

Protein extraction

Figure 15

(a) Azolla biomass from Maharashtra and Tamilnadu region. (b) Protein extraction using rotary film evaporator. (c) crude protein and their inorganic fraction. (d) HPLC confirmation of presence of protein at high temperature

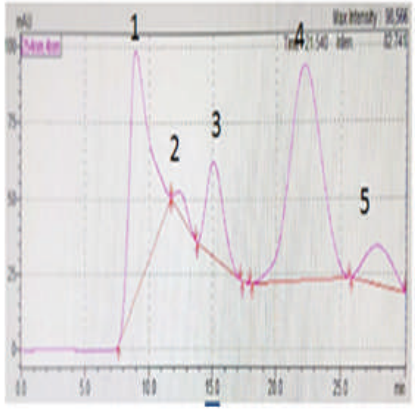
(c)



Tamilnadu (TN) region

Maharashtra (MH) region

(d)



HPLC confirmation of presence of protein at high temperature

Bioprospecting

We are focusing upon isolation and synthesis of naturally occurring compounds, derivatives and their use in pharmaceuticals, nutraceuticals, agriculture and industries. We are deciphering the mechanistic details of action of these compounds for treatment of disorders such as Alzheimer's disease, anemia, diabetes, cancer, and chikungunya.

Natural Product Chemistry

Secondary metabolites from lichens

Morpho-anatomy and chemotaxonomic studies of over sixty lichen specimens, collected from different forest localities of the Western Ghats have been carried out. Of these, twelve lichen species have been selected on the basis of their therapeutic effects on various diseases in traditional system of medicine in order to find out possible metabolite from natural resource. These species are *Nephromopsis laii*, *Stereocaulon foliolosum*, *Flavoparmelia caperata*, *Cladonia furcate*, *Flavopunctelia flaventior*, *Everniastrum cirrhatum*, *Cetrelia pseudoolivetorum*, *Heterodermia diademata*, *Heterodermia boryi*, *Heterodermia hypocaesia*, *Parmotrema tinctorum*, and *Parmotrema reticulatum*.

The current effort is to develop antioxidant-based approach for endogenous defense against oxidative stress through dietary or pharmacological intake of antioxidants. Two secondary metabolites, Atranorin and Zeorin were isolated from the lichen species *Heterodermia diademata* by PTLC and further confirmed with UHPLC analysis. In a preliminary experiment carried out in the laboratory, the lichen compound Zeorin showed promising neuroprotective potential via antioxidation, AChE inhibition and cytoprotective activity against H_2O_2 induced toxicity in mouse Neuroblastoma (N2a) cell line.

3-acetylcoumarin thiosemicarbazone thiosemicarbazone and its derivatives as multi-target drugs for Alzheimer's disease

Alzheimer's disease (AD) is a multifactorial brain disorder that involves several pathophysiological events like amyloidogenesis, acetylcholine deficit, neuroinflammation, cellular oxidative stress and dysfunctional autophagy. Hence, to cure AD, it is necessary to target multiple mechanisms involved in the development and progression of AD.

This study reports a novel methyl-substituted 3-acetylcoumarin thiosemicarbazone (ACT) derivative, viz. [(2E)-N-methyl-2-[1-(2-oxo-2H-1-benzopyran-3-yl) ethylidene] hydrazine-1-carbothioamide], (ACMT), and the protective effect of these compounds towards acetylcholinesterase activity, inflammation and autophagy induction. The crystal structure of ACMT is solved by using singlecrystal X-ray diffraction.

The molecular docking studies showed that the methyl substitution of 3- acetylcoumarin thiosemicarbazone modulates its hydrophobic and hydrogen-bonding interactions with the active site of acetylcholinesterase enzyme (AChE) (Figure 16).Docking analysis revealed that molecular interactions of ACT involve hydrophobic

interactions with Asp72, Ser122, Phe330 residues of the PAS region, and also with Trp84 and Gly118 residues of CAS region of AChE (Figure 16A). It also shows H-bonding interactions with Ser122 and Phe330 residues of the PAS region and π-π stacking interactions with Trp84, which is one of the essential amino acids of the CAS region of AChE. ACMT showed hydrophobic interactions with Phe331 of PAS as well as Trp84, Phe330, and Gly118 of the CAS region (Figure 16B). It further showed hydrophobic as well as p-p stacking interactions with Tyr334 of the mid gorge region of AChE. Thioamide substitution of ACT with -CH3 group in ACMT was found to be responsible for hydrophobic interaction with Gly441 and Phe331 of AChE enzyme pocket that may cause increase in AChE inhibitory potential.

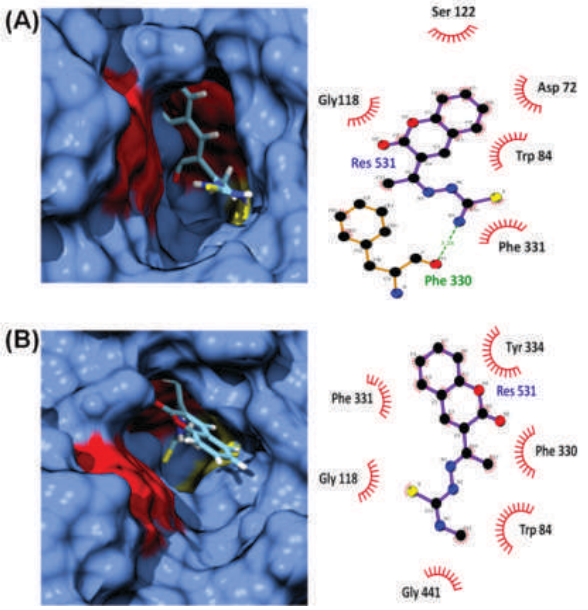


Figure 16
Docking and ligplot analysis of AChE in the presence of (A) ACT, (B) ACMT. PAS and CAS regions of the AChE enzyme are highlighted in red and yellow color, respectively

The up-regulation of autophagy is a desirable approach for the autophagic clearance of aggregated proteins, viz., β-amyloid peptides, and tau, which are the targets for AD therapeutic interventions. Herein, the potential of 3-acetylcoumarin thiosemicarbazone derivatives to regulate autophagy was studied using a stable SH-SY5Y cell line transfected with mCherry-GFP-LC3. For this study, we have engineered the pAutophagSENSE vector to carry mCherry tag upstream of the existing GFP-LC3 gene. This recombinant construct transfected the SH-SY5Y neuroblastoma cells to produce a stable cell line that sustainably expresses the transgene mCherry-GFP-LC3 even after the host cells replicate (Figure 17).The control cells show diffuse fluorescence in the cytoplasm corresponding to LC3 protein in the cytoplasm. Further, when the cells were treated with rapamycin, which is a known inducer of autophagy in cells, numerous LC3 puncta were visible due to the incorporation of mCherry-GFP-LC3 in the membrane of the autophagosome (Figure 17A). When these cells were treated with ACT and ACMT, the LC3 protein is seen on the membranes of autophagosomes (yellow puncta) and autolysosomes (red puncta) (Figure 17B). Robust induction of autophagy was detected, as seen by confocal imaging. The results indicated that the formation of red puncta was higher than yellow puncta, i.e., the formation of autolysosomes was higher, indicating the increased rate of autophagic flux upon treatment with both the compounds. The

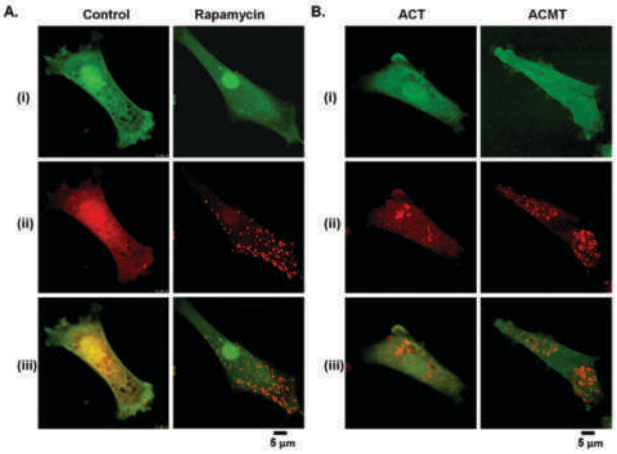


Figure 17
(A) Confocal images of SH-SY5Y neuroblastoma cells stably expressing mCherry-GFP-LC3 revealing diffuse fluorescence corresponding to cytoplasmic LC3 protein and formation of fluorescence puncta in the presence of rapamycin; (B) Induction of autophagy by 3-acetylcoumarin thiosemicarbazone derivatives (5 µM) in stably transfected SH-SY5Y cells; For both (A) and (B): Row (i) GFP-LC3, Row (ii) mCherry-LC3 and Row (iii) Merged image of (i+ii). The columns show images of cells treated with the respective compounds as mentioned

number of autolysosomes was significantly increased in ACMT-treated cells, while the number of autolysosomes formed upon treatment of ACT was relatively less. Overall, the data showed that the treatment of SH-SY5Y neuroblastoma cells with these thiosemicarbazone compounds resulted in an increased rate of autophagic flux and the compound with methyl substitution represented greater potential to enhance autophagic flux.

Antiinflamatory properties of *Crinum* extracts in microphage (RAW 264.7) cells

Alzheimer's disease (AD) is a complex neurological disorder. Effective treatment for AD has not yet been discovered. Members of Amaryllidaceae family showed presence of galantamine, an alkaloid having reversible anticholinesterase activity which is used for the treatment of dementia. The genus *Crinum* is a member of the *Amaryllidaceae* family and traditionally has been used to treat a range of ailments such as dementia, fever, pain management, inflammation, cancer, and malaria. We hypothesize that the extracts of *Crinum* species containing alkaloids will provide excellent alternative for the treatment of AD. The medicinal properties of different *Crinum* species especially efficacy against AD are not studied. Therefore, it is highly desirable to explore the bioprospecting potential of *Crinum* species.

We studied the effect of ethanol extracts of *C. woodrowii* and Galantamine on cell viability using the MTT assay. The ethanol extracts of *C. woodrowii* wild rhizome sample showed IC_{50} value of 305.38 µg /mL while the nursery sample showed IC_{50} value of -102.33 µg /mL. The IC_{50} of Galantamine was found to be 52 µg/mL.

To investigate the inhibitory effects of the ethanol extracts of *C. woodrowii* on LPS induced NO production in RAW 264.7 cells, the accumulation of NO in the culture medium was measured. The extracts significantly suppressed LPS-induced NO product in a dose-dependent manner ($p<0.05$). The galantamine also showed significant inhibition of NO production relative to the control.

Synthesis of epoxides of phenanthridinone-triazole conjugates

The development of drug resistance for treating microbes is challenging and it is recalcitrant for effective molecules to sustain a longer duration in the pharmaceutical field as antimicrobial agents. Appropriate redox homeostasis is a fundamental requirement in the life cycle of microbes. The interference in the redox homeostasis can induce stress and restricts the growth of microbes. The small molecules having pharmacophore which can induce redox stress can be effective against drug-resistant microbial strains. Compounds having quinone pharmacophore are known to undergo redox-cycling to generate ROS. Several naturally occurring molecules having quinone backbone have proved to be effective antimicrobial agents. Phenanthridine-triazole conjugate has been obtained by the reaction of 1, 4 dimethoxy-5-(prop-2-yn-1ly) phenanthridine 6 (5H)-one and substituted azides in the presence of sodium ascorbate and copper sulfate. Further, the compound has oxidized to dione using cerric ammonium nitrate, and finally, epoxidation reaction is completed using sodium hypochlorite to afford epoxide end product.

A series of compounds were synthesized in the laboratory and were characterized by spectroscopic analysis. Epoxide ring in the above structure is confirmed by the proton NMR. NMR spectra of (R=2-ClC_6H_4) in which two protons of epoxide ring are confirmed by the two doublets at δ 4.11 and 4.25. The two methylene protons connecting quinone moiety with triazole has been observed as doublets at δ 5.87 and 6.11. Formation of triazole has been detected by the presence of a singlet at 8.02 for a single proton. All other eight aromatic protons are found in the aromatic region between 7.40-8.70 as two multiplets. Activity testing is in progress against tuberculosis.

Computational analysis ofepoxide of phenanthridinone-triazole conjugates

Aminoacyl-tRNA synthetases play an essential role in protein synthesis by producing charged tRNAs, necessary for the survival of the pathogen. Cell-wall synthesis of *Mycobacterium tuberculosis* is essential for its growth. The computational study to understand their binding with target receptors was carried out. The docking scores of -10.8 and -11.8 Kcal/mole were obtained with respective receptors.

Developmental Biology

In the developmental biology group, model organisms Hydra, *Drosophila,* and Zebrafish are used to study processes such as autophagy, cell-cell signaling and cell morphogenesis during development.

Partial complementation of DNA repair defect in human XPA-deficient cells by Xeroderma Pigmentosum A homolog from hydra

Nucleotide excision repair (NER) pathway is a DNA repair mechanism that rectifies a wide spectrum of DNA lesions. Xeroderma pigmentosum group of proteins (XPA through XPG) orchestrate the NER pathway in humans. Here, we examined if HyXPA can functionally complement human XPA-deficient cells and reduce their sensitivity to UV radiation. We found that HyXPA was able to partially rescue XPA-deficient human cells from UV by its binding to chromatin of UV-irradiated cells. However, HyXPA failed to bind replication protein A (RPA70), a key interacting partner of human XPA in the NER pathway (Figure 18). This could be attributed to changes in certain amino acid residues that have occurred during evolution, leading to prevention of some interactions between *Hydra* and human proteins.

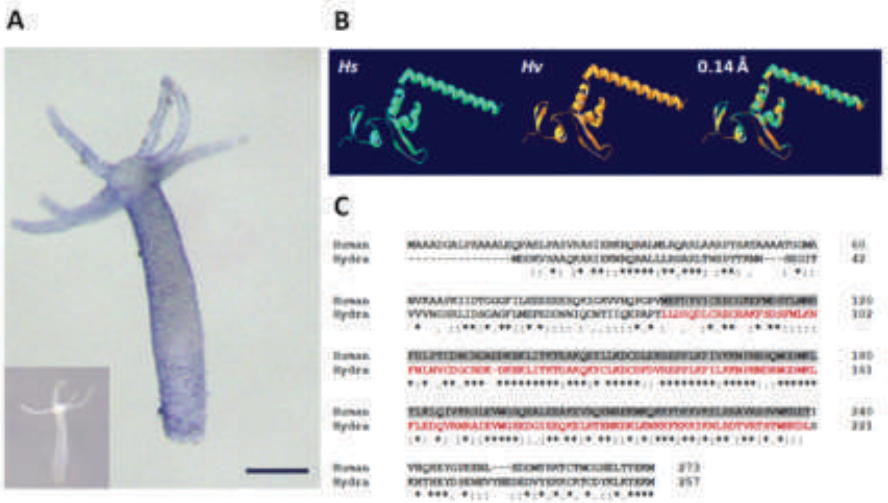


Figure 18

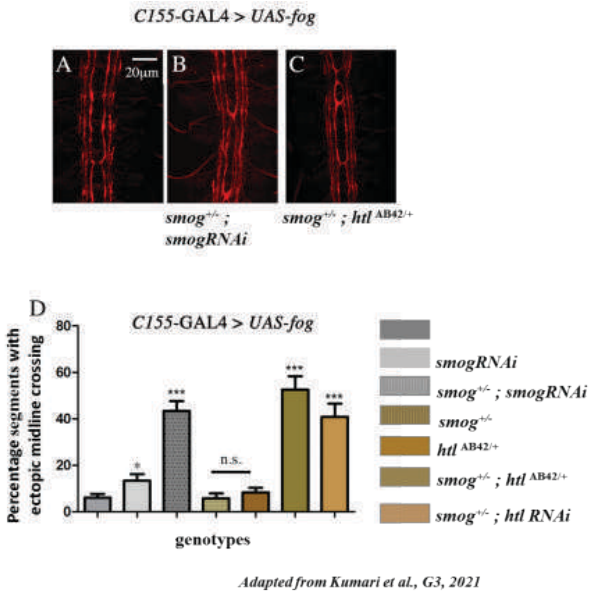
Expression of *HyXPA* and comparison of human (Hs) XPA DNA-binding domain (98-239) and HyXPA (Hv) DNA-binding domain (80-220):(A)HyXPA transcripts were detected in the tentacles and all over the body column, indicating its ubiquitous expression. Inset: Polyp hybridized with sense riboprobes. Scale bar = 200 ì m. (B)Homology modeling was performed using Swiss Model. The template selected for modeling was obtained from PDB (ID 6j44.1.A). Using Swiss PDB Viewer (http://www.expasy.org/spdbv/), predicted protein models were generated for DNA binding domain of HyXPA. Both the structures were superimposed unto each other and low RMS value obtained (0.14 Å) indicated close similarity in structures. (C) Multiple sequence alignment of DNA binding domains of human XPA (grey) (98-239) and HyXPA (red) (80-220). This region of human and HyXPA share 58.5% identity and 90% similarity at the amino acid level.

Cross-species complementation may not always be completely successful even when there is considerable identity and similarity in homologous protein sequences. However, unlike HyXPB and HyXPD, which failed to complement human XPB and XPD-deficient cell lines, HyXPA was able to partially rescue human XPA deficient cell line from effects of UV radiation. This finding is significant because it gives insights into the evolution of DNA repair repertoire which originated millions of years ago.

Regulation of Fog mediated GPCR signaling in the Drosophila embryonic CNS.

During morphogenesis, cells undergo change in shape in response to specific spatial cues, essential for processes such as cell division and migration that are important for development. In diseases such as cancer, breach of the basement membrane by tumor cells and their migration leading to metastasis involves cell shape change at each step, making the understanding of mechanisms that trigger and regulate cell shape change important.

In *Drosophila*, the GPCR signaling cascade triggered by the glycoprotein Folded gastrulation (Fog) leads to apical constriction during gastrulation with GPCRs Mist and Smog as mediators of signaling. In the embryonic CNS, Fog regulates morphology and organization of longitudinal glia, and axon guidance. Our recent findings, using gain-of-function genetics, show that in this tissue context, Fog signaling is negatively regulated by Smog and the receptor tyrosine kinase -FGFR/Htl (Figure 19).



Adapted from Kumari et al., G3, 2021

Figure 19
Htl and Smog interact in a synergistic manner to regulate Fog signaling.(A-C) Overexpression of *fog* in neurons leads to ectopic midline crossing (A). This is enhanced upon loss of smog (B) and in the background of a transheterozygous mutant of *smog* and *htl* (C). (D) Quantification of ectopic axonal midline crossing. Embryos heterozygous for *smog* and *htl* show enhanced midline crossing upon *fog* overexpression.

Further, Smog and FGFR/Htl interact in a synergistic manner with the regulation of Smog by FGFR/Htl being post-transcriptional. The role of FGFR/Htl and Smog as negative regulators of Fog-GPCR signaling in the CNS highlights the context dependent modulation of signaling pathways that would be important to regulate tissue/cell-type specific behaviors.

Autophagy is involved in the mitigation of ROS/mROS within the GSC-niche

In metazoans, mitochondria are inherited maternally and are essential for generating energy in the form of ATP within the cells. To ensure cell survival and homeostasis, the conserved process of mitophagy removes damaged and non-functional mitochondria. Mitophagy has been demonstrated to be vital for the proper functioning of germline stem cells (GSCs) that produce sperms and eggs. In Drosophila, the process of mitophagy is dependent on Autophagy-related (Atg) gene products and is necessary to prevent the transfer of mitochondria with the mutated genome into the developing eggs(Figure 20).

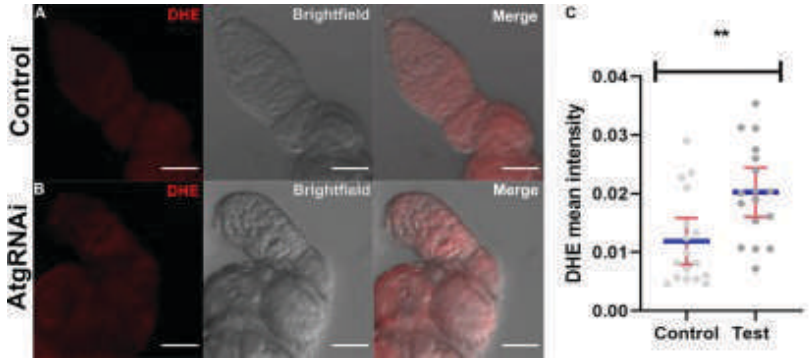


Figure 20
Dihydroethidium (DHE) staining in the germarium of Drosophila. A) Dihydroethidium (red) staining, brightfield image, and merge of control germarium. B) Dihydroethidium (red) staining, brightfield image, and merge of AtgRNAi (autophagy-deficient) germarium. C) Interleaved scatter graph showing mean intensity of DHE staining in germarium per unit area. Error bars represent SD in red, and the mean is blue. *N* = 20. Scale bar= 20µm

Our work demonstrates that several Atg's are essential for maintaining mitochondrial quality in GSCs and for slowing the loss of GSCs from the GSC-niche with age. Further, decreased autophagy causes increased accumulation of reactive oxygen species (ROS) within the cytoplasm of GSCs. Experiments to measure mitochondrial ROS (mROS) in GSCs, usingmROS sensors (previously published from our lab), mito-roGFP2-Grx1 and mito-roGFP2-Orp1, in autophagy-null and autophagy overexpressing backgrounds are being conducted. Our studies will demonstrate the importance of autophagy in the mitigation of ROS and mROS in GSCs and its effect on GSC maintenance and aging.

Secreted protein Ccn2a is necessary for heart regeneration in zebrafish

Myocardial damage is one of the leading causes of death globally as adult human hearts have limited regenerative capacity after injury, typically leading to persistent scarring and reduced heart function. Till date there is no strategy to repair damaged heart muscle (Figure 21). Therefore, the need to explore and develop ways to induce heart regeneration is of critical importance.

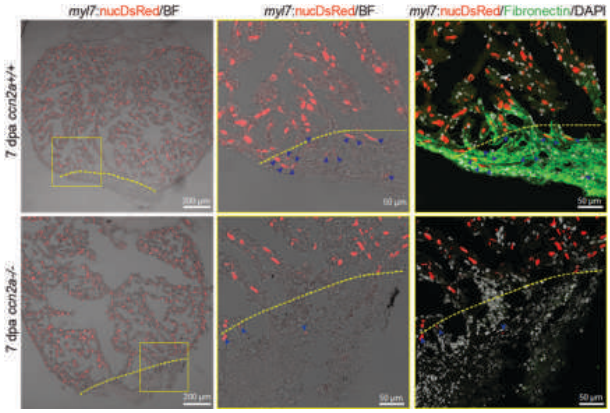


Figure 21
Diminished Fibronectin expression and reduced cardiomyocytes infiltration in the amputated *ccn2a*$^{-/-}$ hearts. Maximum projections of confocal images of 10 µm sagittal cryosections through 7 dpci hearts expressing dsRed in CMs nuclei immunostained for fibronectin (green) and stained for DAPI (white; marks all nuclei). Arrowheads point to CMs nuclei in the injured tissue. Dotted lines mark the injury edge. dpa; days post amputation, BF; brightfield.

We have identified cellular communication network factor 2a(*ccn2a*;zebrafish orthologue of mammalian *CCN2*) as being necessary for heart regeneration and can also augment this process in adult zebrafish. Our findings are as follows:(1) *ccn2a* expression is induced in endocardial cells in the injured heart tissue. (2) Cardiomyocytes (CMs) fail to track along new coronary vessels in *ccn2a* mutants postinjury. (3) Ccn2a is required for CM proliferation and augments this process postinjury. (4) Ccn2a regulates ECM genes and chemokine receptor 3.1 expression by regulating injury associated with TGFβ/pSMAD3 signaling in regenerating heart. Our detailed study shows for the first time that Ccn2a promotes heart regeneration through modulation of ECM components by determining the fate of the scar tissue and thus the heart's ability to repair.

Genetics and Plant Breeding

Agharkar Research Institute is one of the leading centres for improving crops such as wheat, soybean and grapes under the All India Co-ordinated Research Projects funded by the Indian Council of Agricultural Research, New Delhi.

Biotechnology

Biofortification to enhance grain Zn and Fe in durum wheat

ARI is one of the participating centres in studying 'High-resolution QTL mapping for iron (Fe), zinc (Zn), grain protein, and phytate content introgression in high yielding wheat cultivars'. We are identifying QTL/Marker for high Zn, Fe and protein content in durum wheat. Field trials have been conducted for the second year to record morpho-agronomic parameters and the harvested grains will be used to estimate micronutrient content in wheat. DNA samples have been submitted for Single Nucleotide Polymorphism (SNP) genotyping using 35K breeder's array for high-density mapping of genes/QTL for micronutrient content.

Pyramiding of rust resistance genes into high grain quality wheat lines developed through marker-assisted selection

The project aims to deliver newer versions of well-adapted high yielding varieties and new, improved genotypes combining superior grain quality and rust resistance with the best possible agronomic performance. Recipients lines with improved quality parameters (MACS 2496 + *Gpc-B1+Lr24* and NI 5439 + *Gpc-B1+Lr24*) were crossed with the donor for leaf rust resistance HD2967 (*Lr19-Sr25+Lr34*). In the progeny, plants with 3 genes were advanced to the F_3 stage during the season 2020-21 and selections were carried out based on plant morphology. Plants with all 4 targeted genes (*Gpc-B1*, *Lr34*, *Lr24* and *Lr19*) could not be identified in the progeny. Hence inter-crosses have been carried out to pyramid all the target genes together. The inter-crossed F_1s were checked for the presence of these genes, and F_2 seeds were harvested in the 2020-21 season.

Improvement of end-use quality of 1B/1R wheat genotypes using MAS

The replacement of a short arm of wheat 1B chromosome by short arm of rye 1R chromosome (1BL/1RS translocation) has been widely used worldwide to enhance wheat yield potential, rust resistance, and mildew diseases and adaptation. Many popular Indian varieties also contain this translocation. However, the translocation is associated with inherent quality problems associated with reduced dough strength and dough stickiness. However, the sticky dough problem of 1BL/1RS (Glu-B3-/Sec-1+) can be overcome by either removing monomeric secalins and/or addition of polymeric glutenins introgression of new 1BL/1RS (*Glu-B3*$^{+}$/*Sec-1*$^{-}$) translocation. Introgression of this translocation in the background of popular bread wheat

varieties MACS2496, MACS 6222, and MACS 6478 using a marker-assisted backcross breeding approach was undertaken. Plants with desired introgressed segment 1BL/1RS (*Glu-B3*$^{+}$/*Sec-1*$^{-}$) were identified in all three backgrounds. The presence of the *Glu-B3* locus was also confirmed by SDS PAGE analysis. Harvests of all the plants with desired allelic combinations were screened for micro-sedimentation test and thousand-grain weight. Promising lines in each cross combination were identified based on the presence of *Glu-B3*, high micro-sedimentation and high thousand-grain weight and RBD trials were conducted in the 2019-20 season for evaluation of grain yield and end-use quality traits. The same set of lines was sown in the 2020-21 season to confirm the previous year's results. Few promising lines will be identified based on two years of data and promoted to national MABB trials.

Improvement of biscuit making quality using MAS and mutation breeding

A study has been initiated to improve the biscuit making the quality of peninsular zone wheat varieties. A mutant population of a hard grain textured bread wheat MACS 6478 is being screened to identify null allelic mutants for *Glu-A1*, *Glu-B1* and *Glu-D1* loci. Crosses for pyramiding of all the null mutants to generate fewer HMW-GS containing/ null HMW-GS bread wheat were made, and F_2s were obtained. They are expected to have low gluten content and low protein content leading to low gluten, low protein soft bread wheat. Further to study the agronomical and gluten strength properties of these individual *Glu-1* loci mutants against wild MACS 6478, an RBD trial was conducted. The mutants showed similar agronomic properties as wild MACS 6478, but most mutants showed lower gluten strength than wild type.

Influence of fertilizers, date of sowing and genotypes on wheat end-use quality

The end-use quality largely depends on grain protein content and quality, which depends on the supply of Nitrogen, sulphur nutrients, the environment, and genetics of the variety. An experiment was designed to test the effects of Nitrogen, sulphur, date of sowing on end-use quality. Three different Nitrogen doses, three different Sulphur doses with two different sowing dates and three different bread wheat varieties released for PZ were included. The initial results showed protein content largely depends on all three components, i.e. Nitrogen, sulphur and variety, and their interaction. An increase in protein content enhances the gliadins and glutenins but does not increase omega gliadin content. Gluten strength as measured by micro sedimentation is not affected by sulphur and Nitrogen but largely depends on the genetic composition of the variety. This was also confirmed by mixograph dough development time (MPTmin) and bread loaf volume. At the same time, grain yield was affected by Nitrogen, sulphur doses, variety, and the interaction of nitrogen dose and variety.

Water-stress tolerance in soybean

The erratic and uneven distribution of rain during the growth period causes a reduction in the yield of soybean and even complete crop failure. Therefore, identifying water-stress tolerant genotypes and studying the molecular mechanism underlying water-stress tolerance has gained importance in the soybean improvement programme.Water-stress tolerant genotype. RSC-1046 was selected for comparative transcriptome analysis at the late vegetative stage. The transcript assemblies were used to identify new candidate gene-based SSR markers associated with water-stress tolerance in soybean. A total of 15389 cg-SSRs were identified from 62242 transcript assemblies. Among these sequences, 2640 sequences contained more than one SSR, and 1329 SSRs were present in compound form. The most abundant types of repeat motifs were tri-nucleotide (50.41%) and di-nucleotide (46%), followed by tetra-nucleotide (2.05%), hexa-nucleotide (0.85%) and penta-nucleotide (0.58%). These new cg-SSR markers were used to screen genetic variation among sixty-four soybean genotypes. A total of 47 primers were successfully designed using Primer 3.0. Approximately 93.61% (44/47) of these pairs were successfully amplified with the cg-SSR primers.

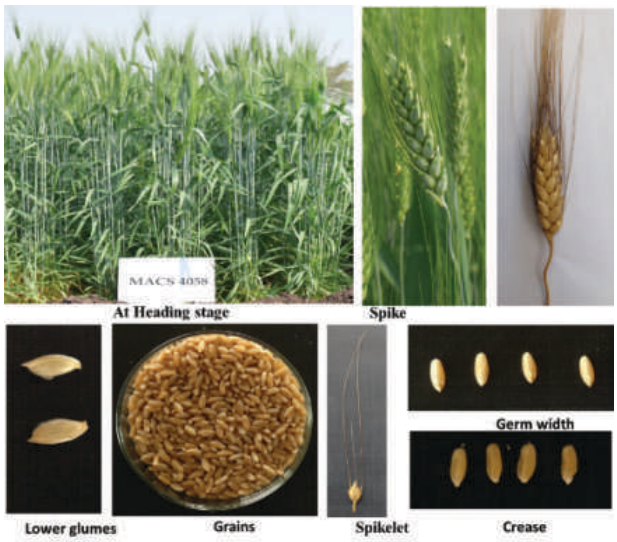
Amongst them, 28 (59.57%) were monomorphic, and 19 (40.42%) were polymorphic. The yield data obtained from the field trials conducted during 2017 and 2018 was used to test the association of newly developed cg-SSR with the water-stress tolerance in soybean. The results showed that the newly developed cg-SSR GmESSR30514 and GmESSR10091 explained 9.63% and 11.67% variation ($P < 0.01$) in the per cent yield reduction under water-stress condition, which indicates a significant association of these markers with water-stress tolerance in soybean. The cg-SSR GmESSR30514 and GmESSR10091 were derived from the transcript assembly encoding and uncharacterized protein and Iron-sulfur assembly chloroplastic-like protein, which showed differential expression in response to water-stress treatment. The results highlight role of these genes in water-stress tolerance and the usefulness of the cg-SSR in the soybean improvement program.

A seedless mutant of grape variety ARI 516

Seedlessness is a highly desirable agronomic trait in grapes as seedless variants are preferred for table grapes and raisin making. A stable seedless mutant of grape variety ARI 516, developed through mutagenesis, is being investigated to understand the molecular basis for seedlessness. Over two years of testing (2019-20 & 2020-21), ARI 516 showed 72.49% normal spherical shape fully developed pollens with 49.78% germination. In contrast, the seedless mutant showed about 72.66% pollens with non-spherical, shrunken, abnormal shape and only 4.33% germination. The results indicated that the seedless mutant of ARI 516 was pollen sterile. Comparative study of ovary structure showed four normal ovules with germinative cells in both wild and seedless mutants. However, the overall ovules size of the seedless mutant was smaller than the wild-type. Comparative transcriptome study showed downregulation of genes related to pollen germination, pollen cell wall formation, pollen tube formation, pollen tube elongation, and signalling pathways related to pollen development in mutant type.

Wheat Improvement

Wheat research at ARI aims to develop high yielding, disease-resistant and end-user quality wheat (*T. aestivum, T. durum* and *T. dicoccum*) varieties for India in the general and peninsular zone in particular. Production of breeder seed is done as entrusted by ICAR/Central or State Government. Institute is also engaged in disseminating the latest technology of wheat production directly on farmer's field through field demonstration.



Biofortified variety MACS 4058

DARE-ICAR declared MACS 4058 as a Biofortified wheat variety (Figure 22). MACS 4058 variety was notified by CVRC GOI, 2019 Gazette. ARI wheat variety, MACS 4058, is the only wheat variety credited with all the three nutritional traits above the baseline levels, Protein, Zinc, and iron (Figure 23).

Figure 22
Newly identified wheat variety MACS 4058(d) for Restricted Irrigation Condition

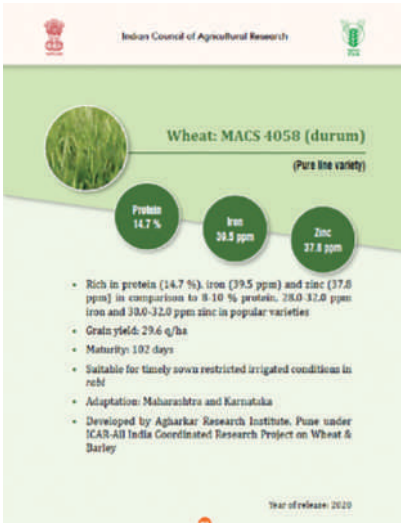


Figure 23
MACS 4058(d) tagged as Biofortified wheat variety (GOI, DARE-ICAR)

Promising wheat entries in the pipeline and an advanced varietal trial

Currently, MACS 6753 and MACS 6755 for restricted irrigation timely sown, MACS 4100 (d) MACS 4106 (d) in PZ while MACS 6768 in CZ for irrigated timely sown and for irrigated late sown MACS 6774 are in advanced varietal trials in the peninsular and central zone. Two entries are in special dicoccum trial MACS 5057 and MACS 5058. A total of 13 MACS entries are advanced to the National initial varietal trial from IPPSN 2019.

Progress in wheat improvement

ARI wheat breeding programme targeted for four agroecosystems viz., rainfed, irrigated full fertility, restricted irrigation, late sown for the development of wheat varieties in all the three species under cultivation (*T. aestivum, T. durum* and *T. dicoccum*). This year we attempted parental cross combinations of 180. The 140 F_1, BC_1Fand top cross combinations generated in the previous year were advanced and screened their hybrid vigour and true F_1behaviour. Segregating breeding materials Total 417 selected bulks and 435 pedigree selections entries from institutional research material tested for breeding components, disease resistance and agronomic performance. Under preliminary yield trial, 296 in irrigated and 274 entries in restricted irrigated conditions were evaluated in augmented breeding design.

This year 13 wheat entries are being evaluated in the national initial varietal trial. Among two were in restricted irrigation, six were in irrigated high fertility (four bread wheat and two durum wheat), three bread wheat entries were in late sown, and two dicoccum entries in the irrigated special trial.

Based on 3 years yield and disease data for station trial, about 35 entries developed at ARI promoted to the national programme on IPPSN (Initial plant pathology screening nursery). From the total of the coordinated trial of 385 breeding entries, 201 plots in agronomy trial, 909 entries for leaf rust, stem rust and foliar blight, 720 plots in IIWBR nurseries, 172 as IIWBR special trials, and 711 entries in coordinated international trials from CIMMYT and ICARDA. Preliminary yield trials were conducted at Hol and Songaon farm. Total 664 plots were evaluated for the yield performance, agronomic characters and disease occurrence at field conditions. A field scouting for disease surveillance in wheat-growing areas of Pune and Satara districts was undertaken, and 10 disease samples submitted for race analysis at central rust laboratory Flowerdale Shimla, Himachal Pradesh.

Wheat breeder seed programme

We have screened genetic purity for seven varieties with 538 nucleus seed bulks (NS-II) and 14 varieties with 1399 head rows as nucleus seed stage-I (NS-I). During the 2020-21 season, 160 q of breeder seed was supplied to different seed multiplying agencies and farmers. The Joint inspection committee monitored the breeder seed plots and satisfied with seed plot quality. This year 210 q of unprocessed breeder seed has been harvested. It will be available for sale during 2021-22 after processing.

Agronomic research findings during 2019-20

In restricted irrigation trial, one test entry, NIDW 1149 (d), was evaluated against five checks, namely HI 1605, AKDW2997-16 (d), UAS446 (d), NIAW 3170 and HI 8805 (d). The increasing irrigation frequency significantly enhanced the grain yield and wheat grain yield obtained at zero. One and two irrigations were 19.88, 20.78 and 22.57 q/ha, respectively. Under one irrigation level, test entry NIDW 1149 (d) was the top yielder, and on a mean basis, it showed significant superiority over all the check varieties. Overall, the mean yield of NIDW 1149 (d) was 17.8% higher than the best check yield of 19.49 q/ha for UAS 446 (d).

While evaluating the performance of three durum test entries DDW 48 (d), DDW 49 (d), and HI 1633 against six checks (MACS 6478, MACS 6222, MACS 3949 (d), UAS 428 (d), RAJ 4083, HD 2932) under timely (5th to 11th November), late (26th November to 2nd December) and very late sown (17th to 23rd December) conditions; on an average basis, check genotype HD 2932 emerged as a top performer in terms of mean yield (31.45 q/ha) under all sown conditions followed by check entry MACS 6478 (30.60 q/ha). Test entry HI 1633 (30.29 q/ha) produced at par yield with the best check variety HD 2932. Under the timely and late sown condition, check genotype MACS 6478 produced the highest yield of 37.92 and 33.49 q/ha, respectively. The highest mean grains/earheadwere produced by test entry DDW 49. The mean yield of test entry DDW 49 was lower over best check HD 2932 even though it produced the highest earhead density. The highest yield of 30.59 q/ha under very late sown condition was recorded for check genotype HD 2932. The boldest grains were produced by check entry MACS 3949 (d).

During the evaluation of optimization of nitrogen doses, the results revealed that maximum grain yield was obtained when 150% of recommended N were applied along with two sprays of growth regulators followed by 150% of recommended NPK were applied along with two sprays of growth regulators. However, these treatments showed numerical superiority but statistically were at par with the recommended dose of N or NPK fertilizers. The data also indicated that the absence of phosphorus and potassium fertilizers did not cause any decline in wheat yield.

The precision nitrogen management trial results indicated that the maximum grain yield was recorded for the treatment having Rich Plot-90 kg N/ha basal + 90 kg N/ha at CRI followed by 75 kg N/ha basal + 37.5 kg N/ha at CRI and tillering and 60 kg N/ha basal + 30 kg N/ha at CRI and tillering and these treatments did not have any significant differences.

Wheat Front Line Demonstrations (FLDs)

During the *rabi* season of 2019-20, 25 frontline demonstrations on wheat were carried out. The recently released rainfed durum wheat variety MACS 4028 was included in the FLD program and MACS 6478, MACS 3949 and MACS 2971 to demonstrate on farmers' fields. The average performance of improved varieties observed was about a 44% increase over local/old wheat varieties. Among improved varietal demonstrated on farmers' fields, MACS 6478 recorded higher grain yield (23 q/acre) over other varieties HD 2189, Lok 1, NI 5439, Ajit 102, Gold 23 checks varieties. The higher net income of Rs. 89,000/ha was recorded with MACS 6478 variety over Lok 1 (Rs.24,250/ha) on farmers' field with a higher B: C ratio of 3.21. MACS 6478 recorded almost double average increase in wheat yield over yield of variety Gold 23 on farmers field among improved varieties. It indicates the significant impact of improved wheat varieties in increasing the yield potential of farmers using old varieties.

Wheat Mini Kit Trials (MKTs)

During 2019-20 we have conducted 20 mini kit trials of wheat comprising all three species aestivum, durum and dicoccum with 20 kg seed of our latest high yielding, disease resistance and quality wheat varieties, namely MACS 6478, MACS 6222, MACS 3949 and MACS 2971 on farmers' fields of different districts of

Maharashtra. The main aim is to promote our varieties to a large number of farmers of the state. We have assisted Minikit farmers by providing technical guidance digitally by telephone and circulating improved wheat production techniques through social media articles. Collection of data were also done digitally through telephone/ WhatsApp communications with respective farmers.

The data recorded from Minikit farmers indicated that among timely irrigated aestivum varieties, the highest yield was recorded by Shri. Balaji Shivaji Bhosale, Pandharpur (Solapur) with variety MACS 6478 (24 q/acre) followed by Shri. Pravin Devidas Pawar, Risod (Washim) with variety MACS 6222 (21 q/acre).While, in the case of durum MACS 3949, Shri. Vinod Shankar Kulkarni, Nashik, recorded a yield of 18 q/acre. In dicoccum, the highest yield of MACS 2971 was recorded by Shri. Vilas Dhondi Pawar with a yield of 16 q/acre at Nigadi (Satara). The farmers were satisfied with the yield potential they achieved with MACS wheat varieties even under the late sown situation due to late rains on the initiation of the wheat crop season. On an average basis, the yield obtained by our varieties were MACS 6478, MACS 6222, MACS 3949, and MACS 2971 were 15.27, 14.80, 18 and 14 q/acre, respectively.

Farmers mela

To share the knowledge of improved wheat production technologies among the farming community, 'KisanMela' was organized every year for the farming community. This year it was organized in collaboration with the State Department of Agriculture, Govt of Maharashtra on farmers field on 10th February 2021 at Sarde Village, Taluka Phaltan, Satara. Mr Vilas Surve has attended the program and delivered the information of Improved Wheat Production Technologies and wheat varieties developed by MACS-ARI to the gathered farmers. About 60 farmers, including farm women, were benefited from the program. Farmers were also benefited by visiting the plots of MACS 6478 and MACS 2971 cultivated by Shri. Sanjay Pawar farm and impressed with the performance of these two varieties and desired to grow such varieties on their farms too.

Soybean Improvement Programme

Evaluation of MACS soybean varieties in All India Co-ordinated Breeding trials

Soybean varieties developed at MACS-ARI, viz. MACS 1701 and MACS 1691 were tested in an initial varietal trial for yield and overall performance at the 32 centres across India. These ranked seventh and fifteenth with a yield of 2084 kg/ha and 1848 kg/ha, respectively. Similarly, 'MACSNRC 1711', a Kunitz tryps in inhibitor-free soybean variety, was tested in soybean early IVT trials of the central zone of India in the year 2020.

Five MACS soybean varieties developed were also tested in the state of Maharashtra through State Multi-location Varietal Trial during the *kharif* 2020.An essentially derived variety (EDV) 'MACSNRC 1667', a null Kunitz tryps in soybean variety, was tested in the third year of AVT-II trial of Southern Zone and gave a yield of 1680 kg/ha. It gave a higher yield over the check entry MACS 450 (1643 kg/ha), from which it is derived.

MACSNRC 1667: Identification of Kunitz Trypsin Inhibitor free (Null KTI) soybean variety for release

A soybean variety MACSNRC 1667 was identified for release in Maharashtra, Telangana, Andhra Pradesh, Karnataka and Tamilnadu. This variety is free from the anti-nutritional factor Kunitz Trypsin Inhibitor and has been developed through marker-assisted backcross selection breeding method (Figure 24). This variety has been identified for release by the central varietal identification committee (VIC) meeting held at ICAR- IISR Indore during the 51st Annual Group Meeting of All India Coordinated Research Project on Soybean held during 12-13 March 2021. Consequently, this variety has been approved for notification and release by the Central Sub-Committee on Crop Standards, Notification and Release of Varieties of Agricultural Crops.

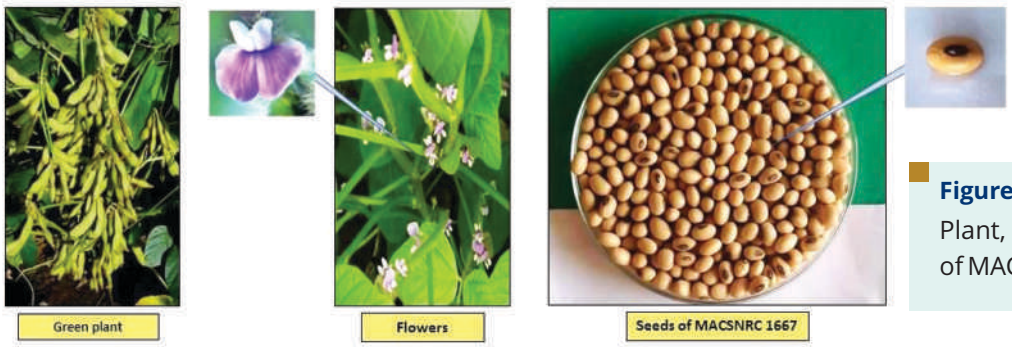


Figure 24
Plant, flowers and seeds of MACSNRC 1667

This variety is essentially derived variety, which has been useful for food use, especially the soy food industry, due to the absence of anti-nutritional factor Kunitz trypsin inhibitor.

Notification and release of three soybean varieties for cultivation

Three soybean varieties with distinguishing traits, developed by the MACS-ARI have been notified and released by 'Central Sub-Committee on Crop Standards, Notification and Release of Varieties for Agricultural Crops' for cultivation in various parts of the country, Gazette notification number CG-DL-E-03022021-224901 and S.O. No.-500(E). These improved and high yielding varieties become the best alternative to the earlier old soybean varieties, which were low yielding and susceptible to various insect-pest and diseases in the respective cultivation zone.

MACS 1407: A high yielding soybean variety suitable for cultivation in the North-Eastern States, mainly in Assam, West Bengal, Jharkhand, and Chhattisgarh. It showed a 17% increase in yield over the best check variety and a 14-19% yield advantage over the qualifying varieties (Figure 25). Variety is highly adaptive to sowing from 20 June to 5 July without any yield loss. MACS 1407 give a yield of 39 quintals per hectare. It is resistant to major insect pests like girdle beetle, leaf miner, leaf roller, stem fly, aphids, whitefly and defoliators. Its thick stem, higher pod insertion (7 cm) from the ground, and resistance to pod shattering make it suitable for mechanical harvesting. This variety requires an average of 43 days for 50% flowering and takes 104 days to mature from the date of sowing. It has white coloured flowers, yellow seeds and black hilum. Its seeds have 19.81% oil content, 41% protein content and show good germinability.

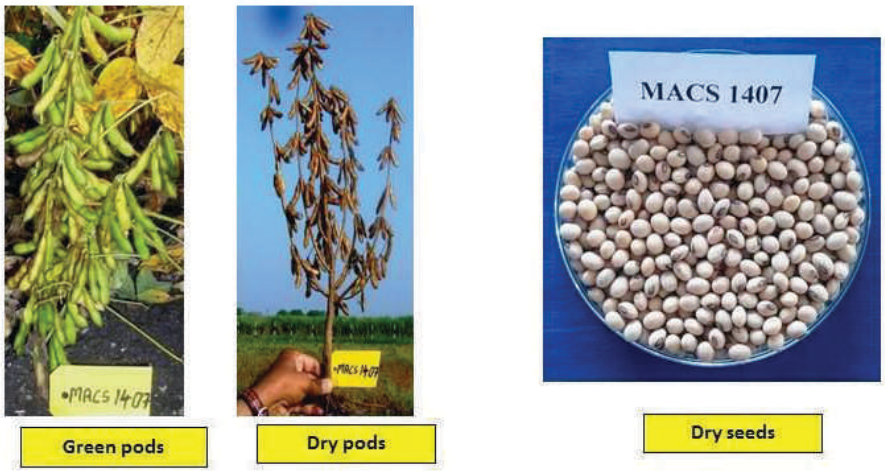
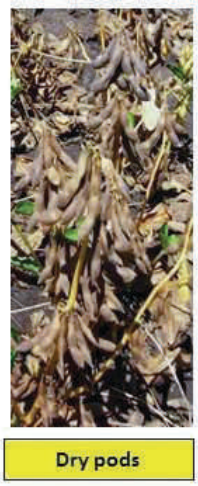


Figure 25
Soybean variety MACS 1407

MACS 1460: It is a widely adaptable short duration soybean variety for cultivation in the Southern zone comprising states of Maharashtra, Telangana, Andhra Pradesh, Karnataka and Tamilnadu; North-Eastern Hill

zone containing states *viz*., West Bengal, Jharkhand, Chhattisgarh, Odisha, Assam and Eastern zone containing north-eastern states *viz*., Manipur, Meghalaya, Mizoram and Nagaland.

MACS 1460 has shown stable yield ability and occupied first, second and fourth rank in all India coordinated breeding trials in Eastern zone, North Eastern Hill zone and Southern zone, respectively. It has shown a high and stable yield during three years of testing in coordinated breeding trials and early maturity (95 days in EZ, 89 days in SZ and 101 days in NEH zone) with the highest per day yield. MACS 1460 has a non-lodging plant type with 3-4 branches per plant and has the determinate type of growth habit, with medium plant height (range 42-58 cm). It persists normal leaf surface with green colour, absence of anthocyanin pigment on hypocotyl, early flower initiation (range 36-40 days), white flowers, and days required for 50% flowering ranges 36-43 days). The hairs are absent on leaf; pods bear without pubescence, and a number of pods per plant 46 on average (Figure 26). It is resistant to pod shattering habit at maturity, round and medium seeds with yellow seed coat colour and light black hilum, with three seeded pods. It has 100 seed weight in the range of 10.62 - 12.29 g., brown pod colour at maturity, and better seed germinability. It has a yield potential of 2198 kg to 3800 kg per hectare.



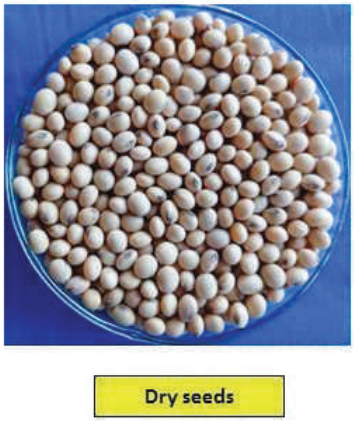


Figure 26
Soybean variety MACS 1460

This variety has field resistance to Aphids, Stem fly, Defoliators, Bihar Hairy Caterpillar, Girdle Beetle and Leaf miner. The seed contains oil in the range of 17.64 -18.91 % and 41% Protein. Agronomically, MACS 1460 was highly adaptive to sowing from 20th June to 5th July without any yield loss. It gave the best yield of 3429 kg/ha at an optimum plant population of 0.45 million plants per hectare. This variety has a thick stem and is non-lodging, and have higher pod insertion (7 cm) from the ground; hence it is suitable for mechanical harvesting.

MACS 1520: This high yielding soybean variety for central Indiais suitable for cultivation in rainfed condition with assured rainfall and medium to heavy soil of the Madhya Pradesh, Bundelkhand region of Uttar Pradesh, Rajasthan, Gujrat and Marathwada and Vidarbha region of Maharashtra (Figure 27). MACS 1520 has shown yield superiority (2149 kg/ha) of 17.1% over the best check NRC 86 (1850 kg/ha) by 16%, national check JS 335 (1655 kg/ha) by 30% in three years coordinated trials at Central zone of India. It has given consistent, high and stable yield during three years of testing and matures in 100 days (mid-late maturity group) with 22 kg/ha highest yield per day. It has a yield potential of 29 q/ha.

Morphologically MACS 1520 has determinate growth habit, non-lodging plant type with 3-4 branches, medium plant height (average 56 cm), normal leaf surface with green colour, anthocyanin pigment present on hypocotyl, it has purple coloured flowers, and its initiation starts at 40th day after sowing and 50% flowering at 44 days after sowing, pods are with pubescence, the number of pods per plant 48 (average), it is resistant to pod shattering habit at maturity, round and medium seeds with yellow seed coat colour and black hilum, three seeded pods, has 100 seed weight 10.50 g (average), brown pod and stem colour at maturity and has

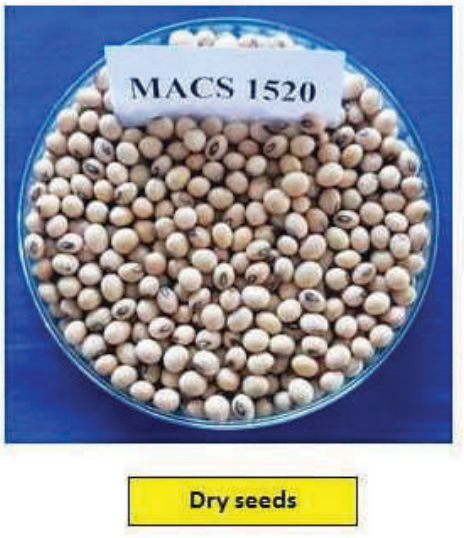


Figure 27
Soybean variety MACS 1520

better seed germinability. MACS 1520 has resistance to Charcoal Rot and Alternaria Leaf Spot diseases. The variety has field resistance to Stem fly, Girdle Beetle and *Spodoptera litura*. Similarly, it showed slight antixenosis against *Spodoptera litura*. It has higher nodulation and leghaemoglobin content in root nodules.

Evaluation of elite soybean entries developed through breeding programme at under station trials

Seventy-eight elite breeding lines were developed and tested in four graded replicated trials. Of these, 7 lines gave significantly more yield than the highest yielding control variety MACS 1188, and out of these, two lines MACS 1724 and MACS 1672 maturing in 85 days with a yield of 2541 kg/ha and 2719 kg/ha, respectively, were found promising. Another entry, MACS 1746 (MACS 1037 x Swarnavasundhara), was identified as a superior vegetable type entry with a green pod yield of 3907 kg/ha and had 100 seed weight 16.57 g with 84 days to reach R6 (full pod) stage.

Evaluation of the agronomic performance of soybean under All India Coordinated Agronomy trials

Eight soybean entries of AVT II were evaluated during *Kharif* 2020 for their performance under different row spacing following the standard package of practices. Sowing done at a spacing of 45 cm between two rows gave a significantly higher yield (2970 kg/ha) over 30 cm (2671 kg/ha) row spacing. The yield obtained with sowing at 45 cm spacing between the rows was 11.19% higher than 30 cm. This translates to additional Rs. 9,568/- gross returns per hectare. Among the entries, DSb 23 (3511 kg/ha), KARUNE (3496 kg/ha) and NRC 142 (3094 kg/ha) gave significantly higher yield over the rest of the entries and check the variety KS 103 (1822 kg/ha). The grain production efficiency and rainfall use efficiency was significantly higher with sowing at 45 cm row spacing over 30 cm.

The partial factor productivity for soybean crop has shown that the full package containing seed treatment, seed inoculation, RDF, weed management, insecticide treatment. Sowing on ridges and furrow gave significantly higher seed yield (2771 kg/ha) of soybean over full package excluding RDF (2100) kg/ha and full package excluding weed management (2277 kg/ha). The differential yield was higher under the treatment where RDF (671 kg/ha) and weed management (494 kg/ha) was excluded from a complete package of practices. Net returns (Rs. 54,940/- /ha) and benefit: cost ratio (2.30:1) was significantly high in the full treatment package over the rest of the treatments.

In an experiment bio-efficacy evaluation of potassium salt of active phosphorus (PSAP) on soybean, the treatment T3: RDF with recommended plant protect, measures without PSAP + PSAP @ 9 g/l (2619 kg/ha) gave significantly higher soybean seed yield over the treatments T7, T8, T9, T10, T11 and T12 whereas it was closely followed by treatments T1, T2, T4, T5 and T6. However, the treatments T4: 75% P&K +75% plant protection measures without PSAP (1: 2.43) and T7: 50% P&K +50% plant protection measures without PSAP (2.45) were more remunerative and beneficial as they have a maximum benefit-cost ratio.

Consultancy and Technical Services Rendered

Two product testing consultancy private firm short term projects on evaluating the plant nutrition products on Tomato crop were undertaken during summer 2020 and 2021.

Soybean breeder seed and nucleus seed production

A total of 210 quintals of breeder seed of soybean varieties, including MACS 1188, MACS 1281 and JS 335, have been produced during the *kharif* 2020 season. This seed will be supplied to the public and private seed multiplying agencies and farmers as a source of pure seed in the year 2021. Similarly, 12 quintals of nucleus seed of soybean varieties MACS 1188, MACS 1460, MACS 1281 and JS 335 have been produced, which can be the source of seed breeder seed production in *Kharif* 2021.

Grape Improvement

Twenty-six cross combinations were attempted using fifteen female parents and four male parents viz during a grape breeding programme. Jumbo, Manik Chaman, Super sonaka and Sarita seedless are useful for developing new disease tolerant varieties that can be used for table purposes. Nine hundred ninety-two seeds derived from the crossing program are being given the chilling treatment for obtaining good germination.

New hybrids developed earlier were evaluated for their fruit quality. Excess rains during September and October attracted many fungal disease incidences, affecting flowering and ultimately fruiting in the season. Berry size was significantly increased when seedless hybrids and mutants were treated with 140 ppm of exogenous GA at 2 mm and 6 mm berry size. Isolation of stable seedless mutant of grape variety ARI 516 is in progress.

Evaluation of grape juice varieties

The trial of evaluation of six juice varieties is planted in Randomized Block Design with 4 replications. Juice varieties were evaluated for berry yield, juice recovery and quality. The yield obtained per vine of ARI 516 (13.0 kg) followed by Manjari Medika (10.46 kg) was significantly higher than the control Bangalore blue (8.88 kg/vine), whereas the significantly lowest yield was recorded in Arka Shyam (2.35 kg/vine). ARI 516 recorded the highest bunches/ vine (94.38), followed by Arka Shyam (70.04). Bunch weight was highest in Manjari Medika (215.71 g), whereas the lowest was recorded in Gulabi x Bangalore purple (90.89 g). Firm Mesocarp was recorded in the variety Manjari Medika while all other varieties showed soft mesocarp.

All the varieties showed on par juice recovery (%), ranging from 56.11 (Concord) to 75.00 (Manjari Medika). Juice recovered in all the varieties was flavoured except Manjari Medika, which is having a neutral flavour. Sensory evaluation of juice was judged on its colour, flavour, consistency, mouth feel, taste and overall acceptance by fifteen volunteers. The variety ARI 516 had the highest "overall acceptability score", followed by Manjari Medika.

Notification of grape variety ARI-516

Central variety release committee, Government of India recommended the grape variety ARI 516 for release and notification for cultivation in 4 states viz. Maharashtra, Punjab, Telangana and Tamil Nadu during the meeting conducted on 28 October 2020. The area under cultivation has increased to one hundred acres.

Nanobioscience

Field-usable diagnostics for detection of viral pathogens in aquaculture

The giant freshwater prawn, *Macrobrachium rosenbergii*, (commonly known as 'scampi'), is farmed extensively across the globe because of its high export potential and resistance to a few viral diseases. However, thelarvae, post-larvae (PL), and juveniles of *M. rosenbergii* are susceptible to the white tail disease (WTD). In an outbreak of WTD, very few infected PL survive beyond 15 days, and survivors may not grow to a marketable size. This disease causes huge mortalities (100%) in about 5 or 6 days after the first gross signs appear. Adults are resistant to WTD but act as carriers. WTD is caused by *Macrobrachium rosenbergii* nodavirus (MrNV) and is transmitted both vertically and horizontally in culture systems. Early detection of *Mr*NV along with good management practices, are crucial in controlling the disease. Currently, WTD diagnosis heavily relies on qRT-PCR, which require modern laboratory facilities, sophisticated equipment, and trained personnel, which are not easily available to farmers in rural areas. We developed a rapid, highly specific, reproducible and sensitive (LOD = 10^4 particles/ng of total RNA) field-usable lateral flow immunoassay (LFA) for detection of *Mr*NV in PL. The results suggest 'good agreement' between the developed LFA and qRT-PCR (Figure 28). The developed LFA is rapid (results within 20 min) and can detect *Mr*NV at an early stage; therefore it has an immense potential of averting losses in 'scampi' farming.

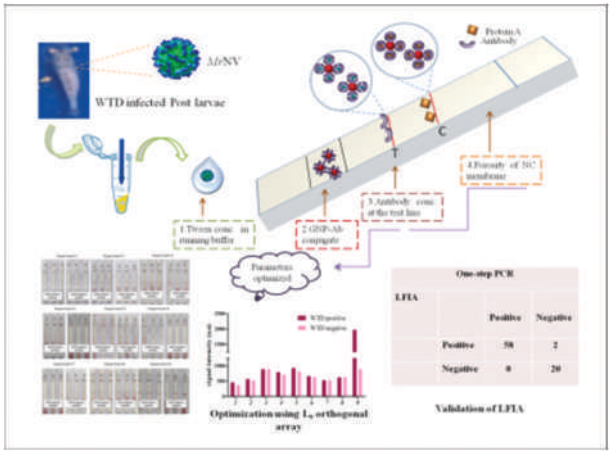


Figure 28
Schematic showing the field-usable diagnostic for detection of *Macrobrachium rosenbergii* nodavirus (MrNV)

Elucidating the molecular interaction of the 12-mer peptide (TFQAFDLSPFPS) for applications as a vaccine candidate

White spot disease caused by the white spot syndrome virus (WSSV) incurs a huge loss to the shrimp farming industry. For the early detection of the WSSV, a 12-mer phage displayed peptide (TFQAFDLSPFPS, designated as *pep28*) was identified and successfully used as a biorecognition probe for VP28 (the surface protein of WSSV) in a lateral flow assay for rapid, on-site use. For determining the structural determinants for the selective binding between VP28 and *pep28*, bioinformatics, structural modeling, protein-protein docking, and binding-free energy studies were performed. The results reveal that *pep28* binds in a surface groove of the monomeric VP28 β-barrel and makes several hydrogen bonds and non-polar interactions. Our studies provide molecular level insights for the selective binding of *pep28* with VP28. The study indicates the possibility of using (TFQAFDLSPFPS) asa therapeutic vaccine candidate.

A multimodal hemostatic xerogel dressing to halt the uncontrolled bleeding

Uncontrolled hemorrhage in accidents and injuries often causes traumatic disabilities or death due to unavailability of an effective first-in-line topical hemostatic agent. Therefore, an efficient multimodal topical hemostat was fabricated with chitosan and gelatin and incorporated with silica nanoparticles (SiNPs, 120 nm size, -22mV charge) and calcium (2.5 mM) (Figure 29). Interestingly, the *in silico* percolation simulation for composite revealed 800 µm long interlinked conduits predicting high absorption capacity which was validated experimentally (640% of composite dry weight). Excellent composite porosity (86.7%) with pore sizes ~30 µm was demonstrated by micro-CT and SEM studies. The composite was >16-fold more effective than commercial Celox and Gauze due to multimodal interaction of its components with RBCs and platelets in *in vitro* blood clotting. The gamma irradiated composite was stable upto 1.5 yr. Moreover, xerogel composite was highly biocompatible. The sturdy composite with a high compressive strength (2.45 MPa) withstood pressure during application. The xerogel composite achieved faster hemostasis (2.5 min) *in vivo* than commercial Celox (3.3 min) and Gauze (4.6 min) in lethal femoral artery injury to rats and was easily removed from the wound. Therefore, the xerogel composite has potential as a rapid topical hemostatic agent to prevent death and disability.

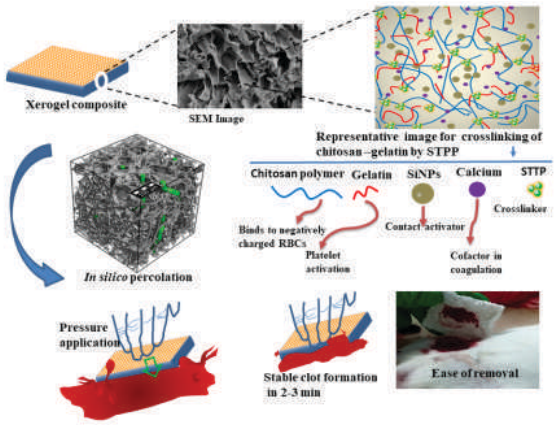


Figure 29
A multimodal hemostatic xerogel dressing

Nanoparticles-mediated foliar dsRNA delivery for RNA interference against gram podborer, *Helicoverpa armigera* in chickpea

The foliar application of pest-specific double-stranded RNA (dsRNA) against gram podborer *Helicoverpa armigera* provides a sustainable alternative to transgenic RNA interference (RNAi) (Figure 30). However, dsRNA degradation by nucleases and pH presents a major obstacle in their practical application. We demonstrate that non-toxic, biodegradable, chitosan nanoparticles (CNPs) protected dsRNA effectively from nuclease or pH degradation and contributed to improved dsRNA uptake in the insect gut. When applied on chickpea leaf surfaces, CNPs-dsRNA complex was stable till 5 d and their ingestion by *Helicoverpa* effectively silenced the targeted genes to suppress the related enzyme activity and resulted in high insect mortality. Moreover, the non-target insects, *Drosophila* and *Spodoptera* were unaffected by the designed CNPs-dsRNA. Remarkably, only two topical sprays of the innovative bioinsecticidal CNPs-dsRNA provided crop protection against *H. armigera* at par with the chemical pesticide, and recorded low pod damage with high yields. These studies can contribute to the progress of topical RNAi sprays in better crop protection.

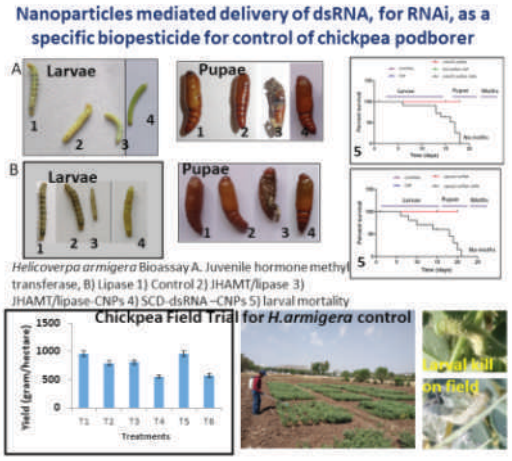


Figure 30
Nanoparticles-mediated foliar RNA delivery for RNAi as a specific biopesticide for control of chickpea podborer, *Helicoverpa armigera*

Chemosensitivity assessments of curdlan-doped smart nanocomposites containing erlotinibHCl

The aim of this study was to develop an anti-cancer drug loaded nanocomposites for the treatment of non-small-cell lung cancer (NSCLC). Erlotinib-loaded curdlan (CN)-doped montmorillonite/poly(N-isopropylacrylamide-co-N,N'-methylene-bis-acrylamide) [CN/MT/P(NIPA-co-MBA)] smart nanocomposites (NCs) were developed and characterized for their *in vitro* performances for lung cancer therapy. The placebo NCs demonstrated excellent biodegradability, pH/thermo-responsive swelling profiles and declined molar mass (Mc) between the crosslinks with increasing temperature. The nanocomposites displayed outstanding drug entrapping capability and sustained biphasic erlotinib elution patterns. The erlotinib release kinetics of the optimal matrices obeyed Higuchi model and their transport occurred through anomalous diffusion. The mucin adsorption behaviour of these matrices followed Freudlich isotherm. As compared to pure erlotinib, the nanocomposites displayed an improved anti-proliferative potential and induced apoptosis more effectively on A549 cells. Thus, the CN-doped smart NCs could be utilized as promising drug-cargoes for lung cancer therapy (Figure 31).

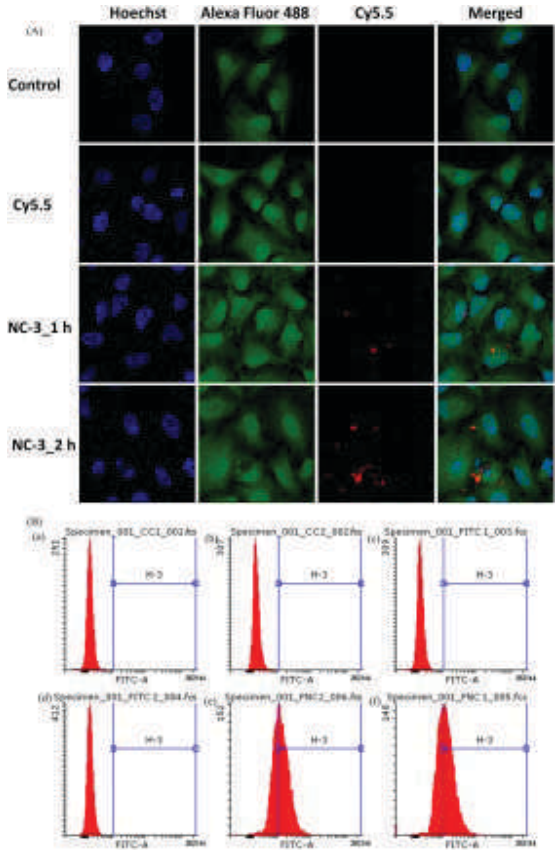


Figure 31
Cellular uptake of Cy5.5- and FITC-tagged NC-3 analyzed by confocal microscopy (A) and flow cytometry (B) [(a) and (b) Control; (c) and (d) free FITC; and (e) and (f) FITC-NC-3], respectively on A549 cells.

Development of nano-immunosensor with magnetic separation and electrical detection of *Escherichia coli* using antibody conjugated Fe_3O_4@Ppy

Detection of bacterial pathogens is the need of the hour due to the increase in antibiotic resistance and the infusion of multi-drug-resistant microorganisms. The conventional strategies such as ELISA, and PCR based tests for the detection are efficient but they are cost, time, lab, and manpower intensive. Thus, warranting a simple and effective technique for rapid detection of bacterial pathogens. Magnetic nanoparticles (NPs) have proved to be better alternatives for separation of bacterial pathogens from a variety of sample sources. However, the use of magnetic NPs has not been successful in the detection of these microorganisms. The current work involves the coating of magnetic NPs (Fe_3O_4) with a conducting polymer (polypyrrole; Ppy) to facilitate simultaneous separation and detection. Electrical (conductivity) measurement was the mode of choice due to the sensitivity, accuracy, and ease it offers. To enhance the conductivity, carboxylic groups were expressed on the Fe_3O_4@Ppy complex and to ensure specificity, *E. coli* specific antibodies were conjugated. SEM images were recorded to ensure bacterial separation at optimal process parameters (Figure 32, 33). The impedance analysis and conductivity measurements were carried out for the sample volume of 15 µl. The bacterial suspension from 10^1–10^6 $CFUml^{-1}$ was successfully detected with a limit of detection of 10 CFU ml^{-1} within 10 min using a simplistic detection method.

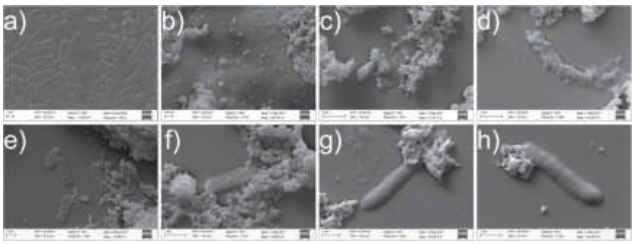


Figure 32
SEM images of (a) only *E. coli*, (b) only Fe_3O_4@Ppy-COOH NPs, (c) 10 µg ml^{-1} NPs incubated with 10^9 cells (d) 1 µg ml^{-1} NPs with 10^9, (e) 10^8 (f) 10^7, (g) 10^6 and (h) 10^5 CFU ml^{-1}

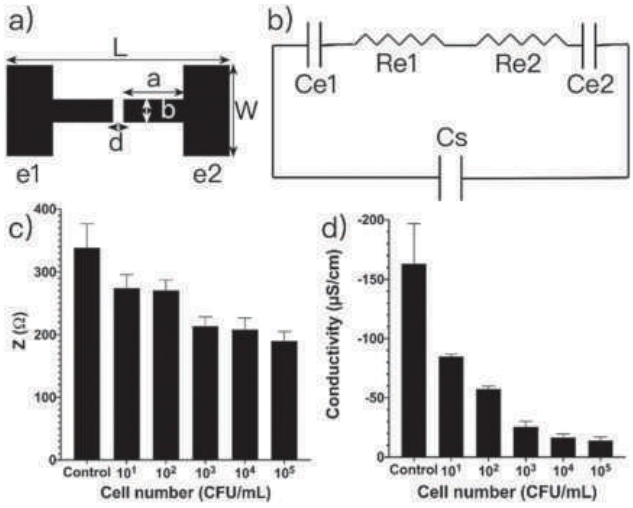


Figure 33
Conductivity measurements carried out using (a) electrode assembly where L and W denote the length and width respectively of the overall design. a and b denote the length and width respectively of the active part of a particular electrode; and d is the distance between two electrodes. The equivalent circuit of the electrode assembly is shown in (b). (c) The concentration of *E. coli* was varied and measured using impedance spectroscopy carried out at 20 kHz. (d) Change in electrical conductivity with variation in *E. coli* concentration was measured using the provided electrode assembly.

Uncovering the roles of miR-214 in Hepatitis E Virus Replication

We have identified the functional importance of an interplay between hepatitis E virus (HEV) and miR-214. Computational analysis indicated that miR-214 binding site is significantly conserved among HEV and related RNA viruses. Intact miR-214 binding site is imperative for HEV replication. miR-214 is an essential host factor for HEV replication. Herein, we demonstrate that miR-214 interacts directly with HEV RNA to enhance HEV replication and HEV genome translation. Augmented translation results in increased levels of HEV ORF2, which is a factor responsible for upregulation of miR-214. HEV usurps host cellular machinery for improving viral fitness and elevates miR-214 expression for amplifying the expression of proviral host factor intracellular active thrombin. This is because miR-214 represses the expression of the negative regulator of thrombin, i.e., protein C. Another viral factor, HEV ORF3, also contributes to the enhancement of intracellular active thrombin. Furthermore, miR-214 directly targets antiviral host factor 2'–5'-oligoadenylate synthetase. Conclusively, we identified a novel mechanism of positive regulation of HEV replication. miR-214 interacts directly with HEV genome and fine-tunes host factors expression. This results in outweighing the proviral factors on the proviral–antiviral axis probably for generating virus supportive environment.

Annexure

Repositories

Agharkar Herbarium at MACS (AHMA)

During the report period, 355 accessions of *Ischaemum* including 46 species are added to the collection of AHMA. Considering earlier high number of Eriocaulaceae specimen and additional specimens of *Ischaemum* from Poaceae family, Agharkar herbarium is making its way to one of the rich collection for monocoats. Moreover, one type specimen of an ecologically important and highly endemic genus *Ischaemum* and one type specimen of an economically important genus *Pseudoxytenanthera* (*Bamboo*) were added to AHMA. Medicinal plants are important sources of herbal drug preparation and we have rich collection of various medicinal plant specimens (around 2000 specimens) from Maharashtra in AHMA which can help in authentication of medicinal plants. Around 32000 various specimens were scanned and made into digital forms.

Ajrekar Mycological Herbarium (AMH)

Ajrekar Mycological Herbarium holds 10341 exsiccate specimens including 115 specimens received from different centers in India for deposit and accession during the period of report.

Animal Facility

Animal Facility at ARI is registered with Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA), Ministry of Environment and Forests, Government of India, New Delhi .The Registration No. of the Facility is 101/ GO/RRcBiBt/S/99/CPCSEA.The Facility has licenses for a) research and breeding of small animals, b) breeding of small laboratory animals (rat and mice) for trading purpose and c) research for commercial purpose.

The facility has a well-organized infrastructure. This year we a) conducted routine genetic and biochemical monitoring of laboratory animals using microsatellite SSLP and biochemical markers; b) conducted two meetings of the Institute Animal Ethics Committee (IAEC) and IAEC approved 28 proposals; c) provided quality and healthy animals by ensuring the persuasion of 4 Rs (Replace, Reduce, Refine, Rehabilitate) of animal experimentation to conduct 10 intra and extramural funded projects; d) provided training for technical staff, students and scientists of different groups of Institute in handling of laboratory animals and also assisted in conducting animal experiments; e) generated revenue for the Institute by selling of the animals and performing projects on the contract basis; f) developed animal models of various diseases that could be used to test various drugs and biologically active molecules, and g) are upgrading the facility by developing a preclinical pharmacological and toxicological testing laboratory.

Crude drug repository

Crude drug repository hosts 2,009 specimens {1978 plant originated (1945 organized and 33 unorganized), 19 animal originated, 12 mineral originated} of plant part used as/in medicine collected from field and or market.

Diatom Collection

Currently our diatom collection holds around 3207 samples covering the present day to Pleistocene period. The present culture collection holds 41 strains from various genera viz; *Gomphonema*, *Stauronies*, *Pinnularia*, *Tabellaria*, *Cymbella*, *Ulnaria*, *Hantzschia*, and *Achnanthidium.*

Fossil Repository

Fossil repository hosts over 8000 fossil type specimens of various animal and plant groups. Over 5000 megafossils include phylum mollusca, brachiopoda, echinodermata, annelida, chordata, bryozoa, and various trace fossils, intertrappean fish, plant fossils as well as recent traces, collected from various localities of peninsular India. Over 2500 microfossils, including foraminifera, pollens and spores are also part of the collection. Revision of taxonomic status of certain specimens considered as trace fossils from the Paleogene of Kachchh was done and deposited as type specimens.

MACS Collection 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.

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

As a part of the conservation of fungal diversity, live, pure and authenticated cultures of interesting fungi received from various organizations in India were deposited and accessioned. The total accession of NFCCI comes to 5010. The fungal germplasm is being maintained in culture collection by following standard long-term preservation methods, like freeze drying, distilled water, glycerol and liquid nitrogen. A total 173 fungi were accessioned during period of report and 25 authentic fungal strains were supplied to various academia, research institution, and industry.

Library & Information Centre

The Library and Information Centre provides access to several international online full-text resources as well as to the databases like Web of Science, J-Gate and maintains the website of the institute. The detailed information about various services and activities of LIC is available on ARI website www.aripune.org. The library is part of a CSIR-DST consortium known as the National Knowledge Resource Consortium. The Library and Information Centre maintains the website of the institute.

The current holdings of the library are:

Particulars	Total	Particulars	Total
Books / Bound Volumes	29773	Maps and Atlases	569
Reference Books	1135	Microfilms / Fisches	636
PhD Thesis	364	Annual Report	10
M Sc / M Phil Thesis	97	Journals	51
ARI Reprints	3599	Digital collection/Documents	3193

Services Rendered/Offered

Crude Drug Authentication Service

ARI has been rendering the authentication service of identification/authentication of crude drug samples/ specimens for academic as well as industrial purposes. During the period of report total 115 authentication reports were generated; out of these, 35 were for industries.

Fungal Identification Service of NFCCI

180 fungal cultures, other samples received from academic, research institution and industry were authenticated/ identified. As such, 126 centers including academic & research institutions and private centers in India benefited from various services of national facility for fungi.

Technical services

The Microbial Culture Collection facility carried out bacterial identification based on 16S rRNA gene sequencing for samples received from academic institutions.

Since ARI is an ICMR recognized laboratory for Covid-19, efficacy testing of various products developed by local companies was done. The products included air ionizers, document and currency sanitizers, negative ion generators, nanoparticle coated face masks etc.

Patent granted

A process for producing a chromium enriched yeast supplement, Granted Patent No. IN358412. Patentee: Sanzyme Private Limited and Agharkar Research Institute

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Papers Presented at Conferences/ Symposia/ Seminars

Oral Presentation/ Participation

Dagar SS. Cultivable diversity of thermophilic anaerobic lignocellulolytic bacteria from Indian hot-springs. 61st Annual Conference - Microbial World: Recent Developments in Health, Agriculture and Environmental Sciences, The Energy and resources Institute, University of Delhi and IARI, 3-5 February 2021

Aher Saurabh, Mangesh Rajguru, Harshita Rana. Sedimentological attributes of the trace fossil bearing Chhasra Formation, Kachchh, Gujarat, 29 September-1 October 2020

Kshirsagar P. Biomass to bioenergy: Important aspects of process parameter optimization. Pune Knowledge Cluster and Serum Institute of India, Pune, 23 February 2021

Poster Presentation

Patil Gokul, Vandana Ghormade. Multimodal chitosan xerogel for rapid hemostasis, 9th Indian Chitin Chitosan Society Symposium, VNIT, Nagpur, 26-28 February 2021

Kadam Kartiki, Vandana Ghormade. Development of essential oil nanoformulations against *Maconellicoccus hirsutus.* 9th Indian Chitin Chitosan Society Symposium, VNIT, Nagpur, 26-28 February 2021

Payal D. Sustainable biomethanation of rice straw without thermochemical pretreatment. 61st Annual Conference - Microbial World: Recent Developments in Health, Agriculture and Environmental Sciences, The Energy and resources Institute, University of Delhi and IARI, 3-5 February 2021

Sonali Mundhe, Ravindra Patil, Santosh Jaybhay, Philips Varghese. Agronomic and transcriptomic response of soybean to water stress. Virtual Conference on Plant Genomes in a Changing Environment, Genetics Society, UK, 12-14 October 2020

Online Participation

Baviskar VS

ICAR-IIWBR Zonal monitoring of Peninsular Zone to monitor the coordinated trials planted at AICRP centres, Maharashtra, 10-13 February 2021

Gaikwad S

National online workshop, Fungal Systematics and Technological Advances. Shree Shivaji Science College, Amravati, 29-30 November 2020

National level online quiz, Knowledge and Awareness on Lichens. SRNMN College of Applied Sciences, Shivamogga and SVS College, Bantwal, Karnataka, 25 June2020

Applications of HPTLC technique in the evaluation of primary and secondary metabolites. Anchrom Enterprises (I) Pvt. Ltd., Mumbai and Bharati Vidyapeeth's College of Pharmacy, Navi Mumbai, 22 June 2020

Role of HPTLC in Fingerprint Analysis of Herbal Drugs and Formulations as per the Regulatory Perspective. Anchrom Enterprises (I) Pvt. Ltd., Mumbai and Shri Vishnu College of Pharmacy, Bhimavaram, 9 July 2020

Rare fungal spores as trace evidence and intelligence in forensic investigations. Satish Pradhan Dnyansadhana College, Thane in collaboration with Mycological Society of India, 25 July 2020

Instrumentation and Applications of Ion Chromatography. Metrohm India Pvt. Ltd. in collaboration with Agharkar Research Institute, Pune, 27 August 2020

Patra C

Cancer Modelling in Zebrafish, International Zebrafish Society (IZFS), 17 November 2020

Paper writing workshop, IZFS, 17 February 2021

Behaviour & Neuroscience, IZFS, 25 March 2021

Scientific writing, DBT/Wellcome Trust India Alliance

Ratnaparkhi A

Online symposium, Molecular and Developmental Biology of *Drosophila*. MACS-ARI, Pune, 22-26 June 2020

Shravage BV

Autophagy, lysosomes and membrane trafficking in health and disease, Institute of Life Sciences and European Molecular Biology Association, 15 October-6 November 2020

Yashavantha Kumar

Monitoring of Peninsular Zone to monitor the coordinated trials planted at AICRP centers, Karnataka, 9-12 February 2021

Keynote address, Invited/ Lead Lectures, Teaching, Resource person

ARI Scientists participated in several online meetings, training courses and programmes during the Covid-19 pandemic.

Baviskar V

Improved wheat production technologies. Department of Agriculture, Baramati and Farmers Producer Company, Baramati, 21 February 2021

Choudhary RK

Recent perspectives in plant taxonomy with special emphasis on DNA Barcoding. International conference, Shri Pancham Khemraj Mahavidyalaya, Savantwadi, Maharashtra, 15 June 2020

Phytodiversity research and conservation in India against the backdrop of COVID-19 crisis. St Xavier's College, Mumbai, 22 February 2021

Omega taxonomy vis-a-vis Phytodiversity documentation. Dr MC Gopinathan Endowment lecture, Victorian Botany Alumni Association, Government Victoria College, Palakkad, Kerala, 27 February 2021

Datar MN

Plant-bird interaction. School of Environment and Nature Conservation, Jalgaon, 30 August 2020

Sacred grove conservation as a part of wildlife week celebration. State Forest Department, Nagpur, 5 October 2020

Ghormade V

Chitosan based hydrogels for rapid hemostasis. 9th Indian Chitin Chitosan Society Symposium, National Institute of Technology, Nagpur, 26-28 February 2021

Nanotechnology for healthcare. National webinar, PES College of Arts and Science, Ponda, Goa, 28 October 2020

Nanotechnology: Small in size by big in innovations. National Webinar, 7 October 2020

Detection of fungal pathogens and contaminants: Mycological Society of India, Mumbai, 29 May 2020

Karthick B

Application of diatoms in archaeology: A review and way ahead. Sharma Centre for Heritage Education, Chennai, 1 May 2020

Algae in human life. Tamil Nadu Science and Technology Centre and Vigyan Prasar, New Delhi, 23 May 2020

The natural ventilators and its biotechnological applications. International Webinar, Biotechnological perspectives. Kamaraj College of Engineering and Technology, Virudhunagar, Tamilnadu, 28 May 2020

The Diatoms.World Environmental Day webinar series. Central University of Punjab and The Indian National Young Academy of Sciences, 3 June 2020

Biogeographic patterns and community structure of diatoms across the Western Ghats. National Centre for Biological Science, Bengaluru, and Indian Institute of Science Education and Research, Tirupati, 14 September 2020

Algae in human welfare: Oxygen to medicine. Lecture Series, Yenepoya Research Centre, Mangalore, Karnataka, 23 September 2020

How to become a scientist. 83rd Founder's Day Lecture Series, Children's Garden School Society, Mylapore, Chennai, 10 October 2020

Application of diatoms in forensic sciences. Lecture Series, Yenepoya Research Centre, Mangalore, Karnataka, 14 October 2020

River biomonitoring using diatoms.Biomonitoring and indexing of river ecosystem for pollution monitoring. SIES-Indian Institute of Environment Management, Mumbai, 28 November 2020

Epistemology in biodiversity research with emphasis on taxonomic research. International Research Journal of Tamil and Prizah Research, 16 December, 2020

Looking at Living Glass houses. OutsideIn, NCBS and Bangalore Life Science Cluster, 20 December 2020

Past, present and future of diatom research in indian subcontinent. University of Calcutta, 28 January 2021

Diatoms and river water pollution, 1 February 2021

Biotechnological applications of diatoms. Muthayammal College of Arts & Science, Tamil Nadu, 15 February 2021

Diatoms for biofuel production. Microbial processes for energy recovery from organic wastes. Pune Knowledge Cluster and Agharkar Research Institute, 17 February 2021

Kaushik T

An integrated approach for taxonomic reassessment in foraminifera using morphological and molecular tools. Marine Ecology Laboratory, Presidency University, 23 September 2020

Kulkarni KG

Role of ichnology in palaeontology and related geosciences. Institute of Science, Aurangabad, 29 August 2020

Trace fossils... they reveal what body fossils don't. Palaeontological Society of India, Pune-Mumbai Chapter, 13 October 2020

Palaeontology: Its divisions, scope, importance and applications, Savitribai Phule Pune University, 16 February 2021

Navathe S

Wheat diseases. MS Kakade college, Someshwarnagar, Baramati, Maharashtra

Patil R

Advances in molecular breeding. SP Pune University and Prof. Ramkrishna More Arts, Commerce and Science College, Akurdi, Pune, 9-10 December 2020

Advances in molecular plant breeding. TC College of Art Science and Commerce, Baramati, Pune, 12-13 June 2020

Patra C

Zebrafish. Brainware University, Kolkata

Rajwade JM

Biomedical applications of bacterial nanocellulose. Modern College of Arts, Science and Commerce, Pune, 11 February 2021

Phage display: Technique and applications. Savitribai Phule Pune University, 19 January 2021

Rahalkar MC

Microbial processes for energy recovery from organic wastes. Methanotrophs: Biodiversity, mitigation potential and biotechnology. Pune Knowledge Cluster-Agharkar Research institute, 23 February 2021

Shravage BV

Investigations of the role of autophagy in stem cell maintenance and aging. 11th RLS conclave, Department of Biotechnology, Government of India, 15 December 2020

Singh PN

Isolation and qualitative analysis of phosphate solubilizing fungi: An eco-friendly approach. Virtual National Conference, Biodiversity & Biotechnology of Fungi. Punjabi University, Patiala, 22-24 February 2021

Taxonomy of Micro-Fungi: A perspective. National Webinar, MS University Vadodara, Gujarat, 10 July 2020

The early and modern classification of fungi: A perspective and study on fungi. International web conference, Science, Engineering & Technology (IWCSET-2020). Society for Technologically Advanced Materials of India, 16 May 2020

Biocontrol of powdery mildew of grapes using cell-free culture filtrate and biomass of fungal isolates: An eco-friendly approach. International virtual webinar, Fungal Biotechnology: Recent Trends and Future Perspectives, Bannari Aman Institute of Technology, Erode, Tamil Nadu, 11 December 2020

Singh SK

Regional Expert, Consultation on Agriculturally Important Microorganisms, Asia-Pacific Consortium on Agricultural Biotechnology and Bioresources (APCoAB), 28 October 2020

Fungal systematics and technological advances. Mycological Society of India, Shri Shivaji Science College, Amravati, 29-30 November 2020

Regulatory framework on fungal bioresources and their conservation. Shoolini University of Biotechnology and Management Sciences, Solan, 22 December 2020

Yashavanthakumar K J

Wheat breeding and procedures for developing new varieties. MS Kakade college, Someshwarnagar, Baramati, Maharashtra

Honours/ Awards

Choudhary RK

Prof. VV Sivarajan Gold Medal for outstanding contributions to the field of plant taxonomy. Indian Association for Angiosperm Taxonomy, 4 December 2020

Patra C

Extension, JSPS Invitational Fellowships for research in Japan

Mundhe Sonali

Short-term research studentship under Newton-Bhabha PhD placement programme 2020.

PhD degree award

Student, Subject	Thesis	Guide, Co-Guide
Henry Kolge *Biotechnology*	Silencing of *lipase* and *juvenile hormone acid methyl transferase* gene(s) in *Helicoverpa armigera* via dsRNA-nanoparticles	Ghormade V
Prajakta Tambe *Biotechnology*	Nanocarrier mediated siRNA delivery for targeting LHRH overexpressing cancer cells	Gajbhiye V Paknikar KM
Pramod Kumar *Biotechnology*	Nanoparticles mediated co-delivery of drug and siRNA for treatment of drug resistant cancer	Gajbhiye V Paknikar KM
Gayatri Kanade *Biotechnology*	Role of non-coding regions in the Hepatitis e virus RNA genome	Karpe YA
Soham Pore *Microbiology*	Biomethanation of rice straw at elevated temperature: Assessment of microbial community dynamics	Dhakephalkar PK Dagar SS
Sneha Maheshwari *Microbiology*	Metagenome and metatranscriptome analysis to gain insights into biomethanation of rice straw	Dhakephalkar PK
Pranita Pandit *Biotechnology*	Exploration of taxonomic and functional diversity of methanotrophs associated with lowland paddy fields	Rahalkar MC
Ashwini Darshetkar *Botany*	Molecular Phylogeny of the genus *Eriocaulon* L. in the Western Ghats, India.	Choudhary RK

Supervision of PhD students

(Guide, Co-Guide, Student, Thesis)

Biodiversity & Palaeobiology

Plants & diatoms

Choudhary RK

Maurya S. Biogeography, diversification and molecular phylogenetics of genus *Capparis* L. in the Indian subcontinent

Vigneshwaran A. Diatom diversity across the streams and rivers of the Western Ghats and its application in water quality monitoring

Datar MN

Kulkarni A. Plant life between inundation and desiccation: a study on rock outcrops of Northern Western Ghats, India

Shigwan B. Forests of Northern Western Ghats: diversity, composition and effects of disturbance on tree vegetation

Vijayan S. Study of cliff dwelling vascular chasmophytes from Northern Western Ghats with special emphasis on desiccation tolerant species

Karthick B

Cheran R. Aerophilic diatoms of Eastern Himalayas: diversity and distribution across environmental gradients

Thacker M. Diatoms as indicators of environmental and climatic changes in the *Myristica* swamps of the Western Ghats

Wadmare N. Systematics and biogeography of the genus *Stauroneis* Ehrenberg

(Bacillariophyceae) from the Indian Subcontinent

Fungi and Lichens

Baghela A

Avchar R. Exploration of diversity, taxonomy, phylogeny and biotechnological potential of thermotolerent and thermophilic yeasts from diverse habitats

Mehta N. Deciphering the molecular mechanisms underlying the genetic diversity in the plant pathogenic fungus *Colletotrichum gloeosporioides*

Behera BC

Tiwari S. Diversity, taxonomy, phylogeny and biotechnological potential of yeasts associated with wood-feeding termites of the Western Ghats

Dambare S. Multiplexed detection of bacterial pathogens using LAMP in a single microfluidic chip

Gaikwad S. Studies on selected macro-lichens and their bioactive constituents for its use as pharmaceutical supplements

Singh SK

Lagashetti A. Studies on fungal pigments and their application in dyeing textile fabrics

Rana S. Studies on *Fusarium* spp. for Beauvericin Production and its applications

Rajeshkumar KC

Ashtekar N. Studies on taxonomic complexities of Indian *Penicillium* species following polyphasic taxonomic concept

Singh PN

Pawar K. Studies on Alkaliphilic Fungi for Alkaline Protease Production and its Applications

Palaeobiology

Kulkarni KG

Salunkhe SN. Ichnological studies of the late Oxfordian-Kimmeridgian Baisakhi Formation, Jaisalmer Basin, Rajasthan, India

Soman AC. Studies in Paleogene bivalvia from Kachchh with special reference to palaeozoogeographic considerations (Co-guide)

Bioenergy

Dagar SS

Deore K. Thermophilic methanogenic archaea from hot springs and oil reservoirs, and their application

Gaikwad S. Bacteriophages for inhibition of sulfate reducing bacteria associated with oil reservoir souring

Hivarkar S. Investigating diversity of thermophilic anaerobic bacteria from hot spring environments for utilization of agricultural biomass

Dhakephalkar PK

Deshpande P. Enhanced biomethanation of untreated rice straw using anaerobic fibrolytic fungi

Kapse N. Influence of microbial metabolism and reservoir properties on enhanced oil recovery: Insights from simulated laboratory studies

Nagkirti PD. A microbial process for decontamination of saturated and aromatic hydrocarbons associated with terrestrial oil spills

Yadav K. Studies on methanogens at extreme eco physiological conditions: Implications for life on Mars

Rahalkar MC

Khatri K. Conversion of methane to biodiesel using methanotrophs

Mohite J. Utilizing the potential of methane-oxidizing bacteria for methane mitigation and valorization

Bioprospecting

Kulkarni PP

Suryavanshi K. Understanding the role of metal ions in neurodegeneration and inflammation in Alzheimer's disease

Varma M. Thiosemicarbazone derivatives as modulators of Aβ induced oxidative stress and toxicity in Alzheimer's disease

Shete P. Studies on inflammation associated with iron dyshomeostasis and its prevention

Developmental Biology

Ghaskadbi SM

Turwankar A. Role of VEGF and FGF signaling in regeneration and pattern formation in hydra

Patra C

Joshi B. Role of '*celsr1*' in morphogenesis using zebrafish as a model organism

Rayrikar A. Exploration the role of connective tissue growth factor a in zebrafish development

Daware M. Periostin in zebrafish development (Co-Guide)

Ratnaparkhi A

Basargekar A. Investigation of the role of DMon1 in Drosophila nervous system

Wagh G. Elucidation of the role of selected secreted molecules in zebrafish development

Shravage BV

Murmu N. Determine the role of autophagy in germline stem cell aging in *Drosophila*

Nilangekar K. Determine the role of autophagy in germline stem cell niche in *Drosophila*

Selarka K. Autophagy regulators in the female germline stem cell (GSC)-niche

Genetics & Plant Breeding

Oak MD

Kawade SS. Gluten protein dynamics and wheat end use quality

Methe PS. Development of wheat genotype with good biscuit making properties using marker assisted selection and mutation breeding

Patil RM

Mundhe S. Agronomic, physiological and transcriptomic response of soybean to drought stress at reproductive stage

Venkatesan S. EMS-induced mutations for wheat improvement and their detection by TILLING

Vikhe P. Genetic studies on gibberellin-responsive dwarfing loci Rht14 and Rht18 and their deployment in wheat improvement

Tamhankar SA

Chavan AM**.** Study of the diverse semi-dwarfing genes in durum wheat

Tetali SP

Bagwan JH. Elucidation of physiological mechanisms contributing to resilience of wheat under restricted moisture

Nanobioscience

Bodas DS

Pandey S. Synthesis of multicolour quantum efficient fluorescent nanocrystals using microreactor for the application in bioimaging

Gajbhiye V

Salwe R. Targeted co-delivery of siRNA for effective therapeutic outcome against metastatic ovarian cancer

Ghormade V

Patil G. Development of chitosan based hydrogel for rapid hemostasis

Rahi S. Rapid detection of mycotoxins for ensuring food safety

Jadhav SH

Kulkarni N. Studies on surface functionalized Lanthanum Strontium Manganese Oxide nanoparticles mediated hyperthermia for the treatment of breast cancer

Karpe YA

Patil R. Roles of microRNAs in Hepatitis E virus replication

Pingale K. Interaction of Hepatitis E virus RNA dependant RNA polymerase with host cell proteins

Salunke P. Exploring non-pathogenic protozoa as a eukaryotic platform for protein expression

Rajwade JM

Choudhary S. Increasing seedling vigor in oil-seeds via nano-priming

Padhye A. Evaluation of zinc oxide nanoparticles in delaying the development of diabetic nephropathy

Jamalpure S. Development of multiplexed, point of care (POC) diagnostics for detection of viral pathogens affecting shrimp and prawns

Madiwal V. Nanoscale surface modification of dental material for preventing implant related failures

Khairnar B: Designing and synthesis of novel therapeutic beta sheet breaker peptides for Alzheimer's disease

Organization of Seminar/ Coursework/ Training etc. (Online)

ARI conducted online programmes. Some of them are - HPTLC: Practice, Applications & Regulatory Compliance, 23 July 2020; Instrumentation and Applications of Ion Chromatography, 27 August 2020; ARI student symposium, 29-30 September and 1 October 2020. Three online training programmes were organized for farmers to update them on soybean cultivation.

Constitution Day programme, 1 May 2020-26 November 2020

Vigilance Awareness Week programme, 27 October 2020-2 November 2020

Founder's Day programme (online), 18.11.2021: Director's Report, Film on ARI, Talks by Dr SM Ghaskadbi, Dr Vidya Gupta, Prof. NR Karmalkar, Release of books authored by Dr MN Datar and Dr RK Choudhary at the hands of Dr Anil Kakodkar, President, MACS.

MACS-ARI Platinum Jubilee webinar

Shale Gas and Oil: a Nanometer to Trillion cubic meters: A Tsunami in the world economy

Dr Anand S Kale, Sr Consultant (Geosciences) Bharat Petro Resources Limited (subsidiary of Bharat Petroleum Corporation Limited). 22.12.2020

India International Science Festival (Virtual Mode) 22-25 December 2020, New Delhi

Interaction with students

Students of Architecture, Marathwada Mitramandal College, Pune visited the Palaeobiology laboratory to get an exposure to palaeontology, fossils, processing on fossils, rock cutting machine, fossil cutting machine, grinding machine and foraminifera. 19.1.2021

Film on ARI On the Golden Jubilee Celebrations of DST, Vigyan Prasar made a film on ARI

National Science Day programme, 1.3.2021: Fungal diversity and their industrial potential, Dr SK Deshmukh, Scientific Advisor, Agpharm Bioinnovations LLP, Patiala. 4.3.2021: Basics of IPR, Dr Ashutosh Prachand, Asst. Manager, IP and Tech Transfer, TechEx, Pune

राजभाषा का दर्जा

विज्ञान एवं प्रौद्योगिकी विभाग के राजभाषा अनुभाग व्दारा समय–समय पर जारी विभिन्न आदेशों/निर्देशों का अनुपालन सुनिश्चित करने के लिए निरंतर प्रयास किए जाते है।

राजभाषा संबंधित कार्यों के संपादन एवं राजभाषा विभाग से प्राप्त निर्देशों का सुचारु रुप से अनुपालन करने हेतु संस्थान में हिन्दी समितियाँ गठित की है।

राजभाषा कार्यान्वयन समिति

डॉ. संजय सिंह, वैज्ञानिक एफ, अध्यक्ष
डॉ. अनुराधा रत्नपारखी, वैज्ञानिक एफ, सदस्य
डॉ. मनोज ओक, वैज्ञानिक ई, सदस्य
डॉ. विरेन्द्र गजभिये, वैज्ञानिक डी, सदस्य
डॉ. रितेशकुमार चौधरी, वैज्ञानिक डी, सदस्य
डॉ. अभिषेक बाघेला, वैज्ञानिक डी, सदस्य
डॉ. सुमित डागर, वैज्ञानिक डी, सदस्य
डॉ. प्रतिभा श्रीवास्तव, वैज्ञानिक सी, सदस्य
डॉ. तुषार कौशिक, वैज्ञानिक सी, सदस्य
श्री. प्रसाद गोसावी, क्रय और भंडार अधिकारी, सदस्य
श्री. अब्दुल रहमान, प्रशासनिक अधिकारी, सदस्य
डॉ. गुरुदत्त वाघ, तकनीकी अधिकारी डी, सदस्य
श्री. अतुल चौधरी, तकनीकी अधिकारी डी, सदस्य
श्री. राजेन्द्र जानराव, सहायक लायब्ररी एवं सुचना अधिकारी, सदस्य
श्रीमती. मंजूषा तिवारी, अधिकारी ए, सदस्य

राजभाषा अनुपालन समिति

डॉ. संजय सिंह, वैज्ञानिक एफ, अध्यक्ष
श्री. अब्दुल रहमान, प्रशासनिक अधिकारी, सदस्य
डॉ. गुरुदत्त वाघ, तकनीकी अधिकारी डी, सदस्य
डॉ. रितेशकुमार चौधरी, वैज्ञानिक डी, सदस्य
डॉ. सुमित डागर, वैज्ञानिक डी, सदस्य
डॉ. प्रतिभा श्रीवास्तव, वैज्ञानिक सी, सदस्य
श्रीमती. मंजूषा तिवारी, अधिकारी ए, सदस्य

राजभाषा अधिनियम 1963 (यथा संशोधित 1967) की धारा 3(3) के अंतर्गत आवश्यक सभी दस्तावेजों/ कागजातों को अनिवार्यता से व्दिभाषी (हिंदी–अँग्रेजी) रूप में जारी करने के लिए प्रयास जारी हैं।

प्रशासन विभाग से संबन्धित सभी कागजातों, उदा. अवकाश आवदेनपत्र, कार्यभार ग्रहण रिपोर्ट, अन्य सभी फॉर्मस्, वित्त एवं लेखा विभाग से संबन्धित सभी कागजातों, जैसे यात्रा पर जाने हेतु यात्रा भत्ता के लिए अग्रिम आवेदन, प्रतिपूर्ति का विवरण, अग्रिम राशि के लिए आवेदनपत्र, आकस्मिक अग्रिम राशि का विवरण, तथा क्रय और भंडार विभाग से संबन्धित वस्तुओं का वितरण, भंडार अनावर्ती हस्तांतरण फॉर्म इत्यादि हिंदी में दिया जाना अनिवार्य किया गया है।

कर्मचारियों में हिंदी भाषा के प्रति रुची उत्पन्न हो तथा हिंदी शब्दों से परिचय करवाने हेतू संस्थान के मुख्य भवन में हर रोज एक हिंदी शब्द और उसका अंग्रेजी समशब्द लिखा जाता है।

संस्थान से बाहर तथा आंतरिक ई–मेल्स व्दिभाषी रूप में भेजे गये जिसके रिकार्ड के लिए फाइल बनाई गई है।

आवक रजिस्टर में हिंदी में प्रविष्ठियाँ की जाती है। सेवा–पुस्तिका में सभी प्रविष्ठियाँ और हस्ताक्षर हिंदी में है (अवकाश, पदान्नति, वेतन वृद्धि, इत्यादि)।

उपस्थिती रजिस्टर में कर्मचारियों के नाम और हस्ताक्षर व्दिभाषी होते हैं।

सभी प्रकार के रजिस्टर और फाईलों पर शीर्षक व्दिभाषी में लिखना अनिवार्य किया गया है।

विभिन्न विभागों/ अनुभागों से तिमाही प्रगति रिपोर्ट प्राप्त करने के लिए हिंदी गुगल फॉर्म बनाया गया है।

हिंदी भाषा में अधिक से अधिक टिप्पणियाँ लिखने के लिए कर्मचारियों को प्रोत्साहित किया गया जिससे अधिक्तम लक्ष्य को प्राप्त किया जा रहा है।

संस्थान में साक्षात्कार के दौरान हिंदी भाषा का उपयोग करने का विकल्प रखा गया है।

संस्थान में विभिन्न बैठकों में वार्तालाप हिंदी में होता है।

जनवरी से मार्च 2021 तक की तिमाही में राष्ट्रीय रासायनिक प्रयोगशाला, पुणे की हिंदी अधिकारी डॉ. स्वाति चड्ढा ने कार्यशाला को संबोधित किया।

त्रैमासिक ई–पत्रिका 'संस्कृति' का प्रथम संस्करण (जनवरी–मार्च 2021) कि पीडीएफ प्रतिलिपि केंद्र सरकार के 90 कार्यालयों को ई–मेल व्दारा भेजी गई।

संस्थान के सभी विभाग/ अनुभाग के नामपट्ट व्दिभाषी में लिखे है।

संस्थान में त्रैमासिक बैठकें नियमित रुप से आयोजित की गई और उनसे संबंधित कार्यसूची तथा कार्यवृत्त हिंदी में जारी किए गए।

राजभाषा संबंधित निर्देशों से सभी विभाग/ अनुभाग प्रमुखों को समय-समय पर अवगत कराया जाता है।

हर वर्ष वार्षिक प्रतिवेदन हिंदी और अंग्रेजी में प्रकाशित किया जाता है।

संस्थानकी वेब साइट को द्विभाषी किया गया है।

सभी कम्प्यूटरों पर सारांष हिंदी सॉफ्टवेअर का उपयोग किया जाता है।

संस्थानको प्राप्त तथा संस्थानसे बाहर भेजे जानेवाले सभी पत्रोंकी प्रविष्ठियाँ हिंदी में की जाती है। क, ख, ग क्षेत्रों को भेजे जानेवाले पत्र तथा इन क्षेत्रों से प्राप्त हुए पत्र की कुल संख्या जानने हेतु स्टैम्प बनाया गया है।

सभी साइनबोर्ड, नाम-पट्टों तथा रबर की मोहोरें व्दिभाषी में है।

कोविड-19 के कारण हिंदी दिवस, हिंदी पखवाड़ा का ऑन-लाईन आयोजन किया गया।

हिंदी पखवाडा

हिंदी पखवाड़े का आयोजन 14-28 सितंबर 2020 के दौरान किया गया। इसके अन्तर्गत संस्थान के वैज्ञानिकों, कर्मचारियों एवं समस्त शोध छात्रों के लिए ऑनलाईन व्याख्यान, अपने शोध कार्य का सारांश, निबंध प्रतियोगिता (आत्मनिर्भर भारत: संभावनाएँ एवं चुनौतियाँ), व्यंग-चित्र प्रतियोगिता (कोविड-19 महामारी) का आयोजन किया गया।

दिनांक 14 सितंबर 2020 को कार्यक्रम की शुरुआत करते हुए संस्थान के निदेशक डॉ. प्रशांत ढाकेफलकर ने हिंदी के कार्यालईन उपयोग पर ज़ोर दिया। इस अवसर पर विज्ञान और प्रौद्योगिकी विभाग, राजभाषा विभाग के सहायक निदेशक श्री. कामाख्या नारायण सिंह का हिंदी के उपयोग, प्रचार एवं प्रसार और राजभाषा नीतियों का पालन इस विषय पर ऑनलाईन व्याख्यान आयोजित किया गया।

श्री. कामाख्या नारायण सिंह जी ने राजभाषा हिंदी के उपयोग, प्रचार एवं प्रसार पर मार्गदर्शन और राजभाषा नीतियाँ तथा उनका पालन कैसे किया जाना चाहिए इस पर व्याख्यान दिया। कई उदाहरणों के माध्यम से राजभाषा का महत्व बताया, नीतियाँ, और हिंदी प्रशिक्षण की जानकारी दी। राजभाषा संबंधित कई पुरस्कारोंसे अवगत कराया।

पखवाड़े के दौरान अपने शोध कार्यों का सारांश लिखने कि प्रतियोगिता आयोजित की गई जिस में आनुवंशिकी एवं पादप प्रजनन समूह से चार, जैवऊर्जा समूह से दो तथा जैव पूर्वेक्षण समूह से एक ऐसे कुल सात प्रतिभागियों ने हिस्सा लिया था। प्रथम विजेता (रुपये 2100), व्दितीय विजेता (रुपये 1500) और तृतीय विजेता (रुपये 1100) को नकद राशि से पुरस्कृत किया गया। जैवऊर्जा समूह की डॉ. क्रिती सेनगुप्ता को प्रथम पुरस्कार, सुश्री मल्लिका सुथार को व्दितीय और आनुवंशिकी एवं पादप प्रजनन समूह से सुहासिनी वेंकटेसन को तृतिय पुरस्कार प्राप्त हुआ।

निबंध के लिए 350 शब्दों की मर्यादा थी। कुल ग्यारह प्रतिभागियों ने हिस्सा लिया। निबंध प्रतियोगिता के नकद पुरस्कार की राशि रुपये 1500, 1250 और 1000 थी। जैव विविधता (कवक) समूह के दीपक मौर्य को प्रथम, नैनोजीव विज्ञान समूह से अतुल द्विवेदी और अजय लगशेट्टी को तृतिय पुरस्कार प्राप्त हुआ।

कोविड-19 महामारी विषय पर व्यंग-चित्र प्रतियोगिता का आयोजन हुआ जिसमें कुल दस प्रतिभागियोंने हिस्सा लिया। व्यंग-चित्र प्रतियोगिता के नकद पुरस्कार की राशि रुपये 1500, 1250 और 1000 थी। आनुवंशिकी एवं पादप प्रजनन समूह के डॉ. रविंद्र पाटील एवं विकासात्मक जीव विज्ञान समूह के अमृता निकम को प्रथम, वित्त एवं लेखा अनुभाग के श्रीकांत चव्हाण को व्दितीय और नैनोजीव विज्ञान समूह के नेहा कुलकर्णी को तृतीय विजेता रहे।

दिनांक 21.9.2020 को डॉ. कृष्ण कुमार गुप्ता, सेवा-निवृत्त वैज्ञानिक, केन्द्रिय जल एवं विद्युत अनुसंधान केन्द्र, पुणे व्दारा ऑन-लाईन व्याख्यान दिया। स्लाईडस् के माध्यम से डॉ. गुप्ता सर ने राजभाषा, संसद समिति, हिंदी अनुवाद, प्रादेशिक भाषाओं का महत्व, हिंदी भाषा के विकास के लिए निर्देशों का अनुपालन, अनुवाद आदि जानकारी दी।

दिनांक 28.9.2020 को पखवाड़ा समापन समारोह पर डॉ. आशीष भटनागर, निदेशक आकाशवाणी, पुणे ने हिंदी भाषा और हमारी मानसिकता पर ऑन-लाईन व्याख्यान दिया।

Institutional Research Projects

Sl. No.	Code	Title	Investigators	Staff
Biodiversity & Palaeobiology				
Plants & Diatoms				
1	Bd01	Unraveling the vascular plant endemism of Northern region of Western Ghats	Datar MN	Shigwan B
2	Bd07	Diatom Herbarium and Culture Collection	Karthick B	Wadmare N
3	BOT15	Digitizing Herbarium- AHMA	Datar MN	Joshi VN Karbelkar T
4	BOT17	Repository of Crude drugs, Authentication service	Choudhary RK Kulkarni PP	Kadu M Gaikwad NS
Fungi				
5	MYC02	National Facility – repositories and service (NFCCI, AMH and Identification Service)	Singh SK Singh PN Rajeshkumar KC Baghela A	Maurya D Lad S
Lichens				
6	Bd08	Reappraisal of Taxonomy of Parmelioid Lichens using Morphological, Molecular tools & Phylogenetic analysis	Sharma BO Rajeshkumar KC	Gaikwad S
Palaeobiology				
7	Bd03	Modernization of fossil repository	Kaushik T Kulkarni KG	Rana H
Developmental Biology				
8	ZOO18	Identification and functional analysis of novel regulators during heart development and regeneration	C Patra	Mangade A Bojja S

SPONSORED PROJECTS (as on 31.03.2021)

Sr. No.	Project Code	Project Title	Sponsored By	Investigators
1	ARI/SP/001	All India Co-ordinated Research Project on Soybean (1.4.1968 onwards)	ICAR-IISR, Indore	Mr. S.A. Jaybhay
2	ARI/SP/002	All India Co-ordinated Fruit Improvement Project (1.10.70 onwards)	ICAR-AICRP (Fruits), Bengaluru	Dr. Sujata Tetali
3	ARI/SP/003	All India Co-ordinated Wheat Improvement Project (1.4.1972 onwards)	ICAR-IIWBR, Karnal	Dr. Yashavantha-kumar K. J.
4	ARI/SP/033	Production of Soybean Breeder Seeds of Annual Oil Seed Crops (2.2.88 onwards)	ICAR, New Delhi	Mr. S.A. Jaybhay

Sr. No.	Project Code	Project Title	Sponsored By	Investigators
5	ARI/SP/034	Front-line Demonstrations of Annual Oil Seed Soybean (21.2.89 onwards)	ICAR, New Delhi	Mr. S.A. Jaybhay
6	ARI/SP/043	Front-line Demonstrations in Wheat (1.4.1993 onwards)	ICAR, New Delhi	Dr. V.S. Baviskar
7	ARI/SP/096	Wheat Breeder Seed Scheme (1995 Onwards)	ICAR, New Delhi	Dr. Yashavantha-kumar K. J.
8	ARI/SP/228	Cell-penetrating peptides as drug delivery agents for cancer & Alzheimer DST-INSPIRE FACULTY AWARD (16.05.2014 to 15.05.2019) (Extended upto 15.05.2020)	DST, New Delhi	Dr. Anjali Jha
9	ARI/SP/231	Development of Crude Drug Repository of Genuine samples from Maharashtra (16.08.14 to 15.08.2019) (Extended upto 31.10.2020)	RGSTC, Mumbai	Dr. M.N. Datar
10	ARI/SP/239	"Identification and analysis of extracellular matrix components important for heart development using zebrafish as model organism" (12.03.2015 to 11.03.2020) (Extended upto 31.12.2020)	Max Planck	Dr. Chinmoy Patra
11	ARI/SP/250	"Marker Assisted Elimination of off-flavour generating lipoxygenase-2 gene from kunitz trypsin inhibitor free soybean genotypes" (20.11.2015 to 19.11.2020)	DBT, New Delhi	Dr. M.D. Oak
12	ARI/SP/256	"Investigate the role Autophagy in stem cell maintenance and aging" (25.05.2016 to 24.05.2021) (Extended upto 31.07.2021)	DBT, New Delhi	Dr. B.V. Shravage
13		Role of BMP signaling inhibitors Noggin and gremlin in pattern formation in hydra) (02.05.2016 to 01.05.2019) (Extended upto 31.05.2021)	CSIR, New Delhi	Dr. S.M. Ghaskadbi
14	ARI/SP/264	Development of TILLING resource in Indian durum wheat Bijaga Yellow for forward-and reverse-genetics analysis" (17.03.2017 to 16.03.2020) (Extended upto 16.07.2020)	SERB, New Delhi	Dr. R.M. Patil
15	ARI/SP/265	"Muraina-grasses of India: addressing the polymorphism and interspecific variations through morphological, ecological and molecular phylogenetic studies" (23.03.2017 to 22.03.2020) (Extended upto 22.09.2020)	SERB, New Delhi	Dr. M.N. Datar
16	ARI/SP/266	"Deciphering the past environmental conditions of freshwater myristica swamps of Western Ghats using Diatom assemblages." (17.04.2017 to 16.04.2020) (Extended upto 30.09.2021)	Ministry of Earth Sciences, New Delhi	Dr. Karthick Balasubramanian

Sr. No.	Project Code	Project Title	Sponsored By	Investigators
17	ARI/SP/268	"Conservation of Selected endemic species of orchids of northern western ghats through ex-situ multiplication and reintroduction in wild." (03.05.17 to 02.05.2020) (Extended upto 31.05.2021)	TATA Power Corporation, Mumbai	Dr. M.N. Datar
18	ARI/SP/270	"Exploring Non-pathogenic protozoa as a eukaryotic platform for protein expression (15.06.2017 to 14.06.2020)	DBT, New Delhi	Dr. Yogesh Karpe
19	ARI/SP/271	"Study Role of Untranslated Regions (UTR) in the Genome of Chikungunya Virus" (05.05.2017 to 04.05.2020)	CSIR, New Delhi	Dr. Yogesh Karpe
20	ARI/SP/272	"Ichnological and sedimentological evaluation of the chhasra formation (Burdigalian), Kachchh, Gujarat." (29.07.2017 to 28.07.2020)	CSIR, New Delhi	Dr. K.G. Kulkarni
21	ARI/SP/275	"Metagenomics aided augmentation of resident microbes and their metabolism to enhance oil recovery from depleted reservoirs" (01.08.2017 to 31.07.2020)	DBT, New Delhi	Dr. Anupama Engineer
22	ARI/SP/276	"Elucidating the potential of anaerobic rumen fungi for enhancing biomethanation in anaerobic digesters fed on agricultural wastes" (29.11.2017 to 28.11.2020) (Extended upto 31.10.2021)	DBT, New Delhi	Dr. Sumit Dagar
23	ARI/SP/278	"Determine the role of autophagy in Germline stem cell maintenance" (31.01.2018 to 30.01.2021) (Extended upto 30.04.2021)	DBT, New Delhi	Dr. B.V. Shravage
24	ARI/SP/279	"Freshwater Diversity of Peninsular India (excluding Tamilnadu) Taxonomic enumeration and Development Online flora." (18.01.2018 to 17.01.2021)	Ministry of Environment, Forest and Climate Change, New Delhi	Dr. Karthick Balasubramanian
25	ARI/SP/280	"Role of Dmon 1 at the synapse and regulation of glutamate receptors." (21.03.2018 to 20.03.2021) (Extended upto 20.09.2021)	DBT, New Delhi	Dr. Anuradha Ratnaparkhi
26	ARI/SP/281	"Pyramiding of Rust Resistance Genes into High Grain Quality Wheat Lines Developed Through Marker-assisted Selection." (19.03.2018 to 18.03.2021) (Extended upto 18.09.2021)	DBT, New Delhi	Dr. M.D. Oak
27	ARI/SP/282	"Bioresource and Sustainable livelihoods in North East India." (29.03.2018 to 28.03.2021) (Extended upto 28.09.2021)	DBT, New Delhi	Dr. Karthick Balasubramanian
28	ARI/SP/283	"Digitization and Dissemination of Lichen Specimens at Ajrekar Mycological Herbarium (AMH)" (05.05.2018 to 04.05.2021) (Extended upto 30.11.2021)	RGSTC, Mumbai	Dr. Bharati Sharma

Sr. No.	Project Code	Project Title	Sponsored By	Investigators
29	ARI/SP/284	"Community structure and ecology of Diatoms in the Rocky Pools of the Western Ghats" (02.04.2018 to 01.04.2020)	SERB, New Delhi	Dr. Surajit Roy
30	ARI/SP/285	"Methane oxidizing bacteria : Community structure, elucidation and cultivation from Indian lowland rice ecosystems for future applications" (05.09.2018 to 04.09.2021)	DST, New Delhi	Dr. Pranitha Pandit
31	ARI/SP/286	"Valorization of methane from biogas to biodiesel and single cell proteins (SCPs) using methanotrophs (methane oxidizing bacteria)" (15.09.2018 to 14.09.2021)	SERB, New Delhi	Dr. Monali Rahalkar
32	ARI/SP/287	"Nanoparticles mediated dsRNA delivery for biocontrol of the polyphagous insect pests, Helicoverpa armigera (armyworm) and Scirtothrips dorsalis (thrips)" (02.11.2018 to 01.11.2021)	SERB, New Delhi	Dr. Vandana Ghormade
33	ARI/SP/288	"Effect of amyloid beta peptide on intracellular copper metabolism: Implications to inflammation and neuro-degeneration" (12.03.2019 to 11.03.2022)	SERB, New Delhi	Dr. Prasad Kulkarni
34	ARI/SP/289	"Microbial Production of Hydrogen from Rice Straw" (Upto 06.03.2020) (Extended upto 16.06.2021)	KPIT Engineering Ltd., Pune	Dr. P.K. Dhakephalkar
35	ARI/SP/290	"Engineering multitalented nanotheranostics for silencing the malignant gene in multiple cancers to accomplish eradication of tumor burden" (22.03.2019 to 21.03.2021)	SERB, New Delhi	Dr. Virendra Gajbhiye
36	ARI/SP/291	"Understanding the conidial anastomosis tube (CAT) fusion dynamics and its role in generating genetic diversity in a fungal pathogen Colletotrichum gloeosporioides" (30.03.2019 to 29.03.2022)	SERB, New Delhi	Dr. Abhishek Baghela
37	ARI/SP/292	"Mapping genes/QTL for resistance to spot blotch and stem rust in durum wheat" (26.03.2019 to 25.03.2022)	SERB, New Delhi	Dr. R.M. Patil
38	ARI/SP/293	"High resolution QTL mapping for iron (Fe), zinc (Zn), grain protein, and phytate content and their introgression in high yielding wheat cultivars" (25.03.2019 to 24.03.2022)	DBT, New Delhi	Dr. M.D. Oak
39	ARI/SP/294	"Development, evaluation and molecular characterization of a seedless mutant in Grapes variety ARI 516" (30.03.2019 to 29.03.2022)	SERB, New Delhi	Dr. Sujata Tetali
40	ARI/SP/295	"A chromogenic immunosensor for rapid detection of Vibrio spp. in aquaculture" (25.03.2019 to 24.03.2021) (Extended upto 24.10.2021)	SERB, New Delhi	Dr. Madhuri Keshavrao Pawar

Sr. No.	Project Code	Project Title	Sponsored By	Investigators
41	ARI/SP/296	"Strengthening of seed infrastructure facilities at soybean breeder seed production centers' under the component Creation of seed infrastructure facilities of sub-mission on seed and planting material (SMSP)"	ICAR-Indian Institute of Seed Science, Kushmaur	Mr. S.A. Jaybhay
42	ARI/SP/297	"Crispr- Cas9 based genome-editing approach to explore functions of Actin Binding Proteins in zebrafish: Unravelling F-actin regulation underlying behaviour of cells, tissues and animals" (17.05.2019 to 16.05.2022)	DBT, New Delhi	Dr. Chinmoy Patra
43	ARI/SP/298	"Exploration of cryptic genetic diversity in extant planktic foraminiferal morphospecies from the Southern Indian Ocean" (21.08.2019 to 20.08.2022)	National Centre for Polar and Ocean Research, Goa	Dr. Tushar Kaushik
44	ARI/SP/299	"Microchip for bacterial separation, DNA extraction and multiplexed detection using LAMP" (10.08.2019 to 09.08.2022)	ICMR, New Delhi	Dr. Dhananjay Bodas
45	ARI/SP/300	"Production, nano-delivery and validation of viral vaccine against nodavirus of fish" (24.09.2019 to 23.09.2022)	DBT, New Delhi	Dr. K.M. Paknikar Dr. J.M. Rajwade
46	ARI/SP/301	"Synthesis of small molecules based on redox active natural products and their evaluation as antimicrobial agents" (15.10.2019 to 14.10.2022)	DST, New Delhi	Dr. Ritu Mamgain
47	ARI/SP/302	"Exploration of pro-regenerative secreted molecules and their mechanistic details in heart regeneration using zebrafish as a model organism" (01.10.2019 to 30.09.2024)	IndiaAlliance, DBT wellcome, Hyderabad	Dr. Chinmoy Patra
48	ARI/SP/303	"Understanding Enzymatic Mechanism of Fungal and Algal Growth on Paint Film" (15.11.2019 to 14.11.2020) (Extended upto 30.06.2021)	Asian Paints Limited, Navi Mumbai	Dr. S.K. Singh
49	ARI/SP/304	"Validating the performance of pharmaceutical aerosols by multi-scale simulations and analytical experiments" (11.11.2019 to 10.11.2022)	SERB, New Delhi	Dr.Bothiraja Chellampillai
50	ARI/SP/305	"Augmentation of Cordycepin by Optimizing In vitro Culture Conditions of Caterpillar Fungi" (30.10.2019 to 29.10.2022)	SERB, New Delhi	Dr. Mahesh Yashwant Borde
51	ARI/SP/306	"Exploring the role of Chemokine Receptor 3.1 (Cxcr3.1) in zebrafish heart regeneration using genetic and chemical tools" (31.12.2019 to 30.12.2021)	SERB, New Delhi	Dr. Himanshu
52	ARI/SP/307	"Revisiting the traditional biomethanation: Replacing cattle dung with fibrolytic anaerobic fungi and methanogenic archaea in light of multi-omics approaches" (09.01.2020 to 08.01.2022)	SERB, New Delhi	Dr. Kriti Sengupta

Sr. No.	Project Code	Project Title	Sponsored By	Investigators
53	ARI/SP/308	"Development and demonstration of process for extraction of Azolla protein" (10.02.2020 to 09.08.2020) (Extended upto 09.11.2020)	Biome Technologies, Ahmednagar	Mr. P.R. Kshirsagar
54	ARI/SP/309	"Understanding the regulation of Fog dependent GPCR signaling in the Drosophila CNS" (15.02.2020 to 14.02.2023)	SERB, New Delhi	Dr. Anuradha Ratnaparkhi
55	ARI/SP/310	"Characterisation of Genetic Resources: Germplasm Characterization and Trait Discovery in Wheat using Genomics Approaches and its Integration for Improving Climate Resilience, Productivity and Nutritional quality" "Sub Project-3:Evaluation of wheat germplasm for abiotic stresses" (29.02.2020 to 28.02.2025)	DBT, New Delhi	Dr. Yashavantha-kumar K. J.
56	ARI/SP/311	"10-minute paper-based test kit to detect SARS-CoV-2" (06.07.2020 to 05.07.2021) (Extended upto 05.10.2021)	SERB, New Delhi	Dr. Yogesh Karpe Dr. Virendra Gajbhiye Dr. P.K. Dhakephalkar Dr. D. Bodas
57	ARI/SP/312	"Exploration of triterpenoid metabolite from endophytic fungi of different genotypes of Neem for applications in agriculture" (21.08.2020 to 20.05.2021) (Extended upto 20.08.2021)	Nextnode Bioscience Pvt. Ltd., Kadi - Gujrat	Dr. S.K. Singh
58	ARI/SP/313	"SRB-lytic Bacteriophage Mediated Inhibition of SRB Growth and/ or H2S Production at Pre-pilot scale : Prototype Development and Feasibility Assessment" (15.10.2020 to 14.10.2022)	OECT, New Delhi	Dr. P.K. Dhakephalkar
59	ARI/SP/314	“Studies on Selected Crinum species from Maharashtra for their Bioprospecting potential against Alzheimer’s disease" (08.10.2020 to 07.10.2023)	RGSTC, Mumbai	Dr. P.P. Kulkarni
60	ARI/SP/315	"Evaluation of bioprospecting potential of naturally occurring flavonoids their derivatives and inclusion complexes with biodegradable macromolecules" (17.12.2020 to 16.12.2023)	DST, New Delhi	Dr. Garima Mishra
61	ARI/SP/316	"Unravelling the symbiosis of algal and fungal partners in lichen family Graphidaceae and Parmeliaceae from the Western Ghats through polyphasic taxonomic approach and ecological studies" (30.12.2020 to 29.12.2023)	SERB, New Delhi	Dr. Rajesh Kumar K.C.
62	ARI/SP/317	"Revisiting the taxonomy of the wild relatives of Sarsaparilla (Smilax L.) in India, developing super-barcodes, and understanding their diversification using phylogenomic tools" (30.12.2020 to 29.12.2023)	SERB, New Delhi	Dr. R.K. Choudhary

Sr. No.	Project Code	Project Title	Sponsored By	Investigators
63	ARI/SP/318	"Determine the mechanism of Autophagy-related gene-1 (Atg1) mediated regulation of mitochondrial dynamics during Drosophila oogenesis" (30.12.2020 to 29.12.2023)	SERB, New Delhi	Dr. B.V. Shravage
64	ARI/SP/319	"Fine mapping and marker-assisted breeding for alternative dwarfing genes Rht14 and Rht18 to develop semidwarf wheat genotype suitable for conservation agriculture" (01.01.2021 to 31.12.2023)	ICAR-National Agricultural Science Fund (NASF), New Delhi	Dr. R.M. Patil
65	ARI/SP/320	"Development of new approaches to live attenuated vaccine against Chikungunya virus" (31.12.2020 to 30.12.2023)	SERB, New Delhi	Dr. Yogesh Karpe
66	ARI/SP/321	“Analysis & characterization of probiotic properties of microbial cultures provided by HTBS” (01.02.2021 to 31.01.2024)	Hi Tech BioSciences India Pvt. Ltd., Pune	Dr. P.K. Dhakephalkar
67	ARI/SP/322	"Exploring the role of mitophagy modulators in Parkinson's disease using Drosophila melanogaster" (14.01.2021 to 13.01.2023)	SERB, New Delhi	Dr. Jyotsna Asthana
68	ARI/SP/323	"Translation of proven rapid hemostatic dressing 'Hemo-halt gauze and gel' Prototypes from laboratory to a commercially viable product" (02.02.2021 to 01.02.2023)	DBT, New Delhi	Dr. Vandana Ghormade
69	ARI/SP/324	“Multi-omic characterization of oral biofilm on novel silver-nanocoated and control smooth titanium implant-abutment surfacesas" (06.02.2021 to 05.02.2022)	Dr. D.Y. Patil Dental College & Hospital, Pimpri	Dr. J.M. Rajwade

Personnel (Staff Members as on 31.03.2021)

Director

Dr. P.K. Dhakephalkar

Biodiversity &Paleobiology Group

Fungi

Dr. S.K. Singh, Sci. F

Dr. Rajesh Kumar K.C., Sci. D

Dr. Abhishek Baghela, Sci. D

Dr. P.N. Singh, Sci. D

S. B. Gaikwad, Technical Officer A

D.K. Mourya, Lab. Assistant D

S.S. Lad, Lab. Assistant D

Lichens

Dr. B.C. Behera, Sci. E

Dr. B.O. Sharma, Technical Officer B

Plants and Diatoms

Dr. R.K. Choudhary, Sci. D

Dr. M.N. Datar, Sci. D

Dr. Karthick B, Sci. D

M.H. Mhetre, Lab. Assistant D

N.S. Gaikwad, Lab. Assistant C

S.A. Pardhi, Lab. Assistant A

Palaeobiology

Dr. K.G. Kulkarni, Sci. E

Dr. T. Kaushik, Sci.C

Dr. P.G. Gamre, Technical Officer B

S.S. Deshmukh, Lab. Assistant E

Garden

K.H. Sable, Technical Officer B
S.N. Gajbhar, Attendant D
M.T. Gurav, Attendant D

Bioenergy Group

Dr. P.K. Dhakephalkar, Director
Dr. M.C. Rahalkar, Sci. D
Dr. S.S. Dagar, Sci. D
P.R. Kshirsagar, Sci. D
A.S. Kelkar, Technical Officer C
Dr. V.B. Lanjekar, Technical Officer B

Bioprospecting Group

Dr. P.P. Kulkarni, Sci. E
Dr. P. Srivastava, Sci. C
Dr. R.J. Waghole, Technical Officer A
Dr. A.V. Misar, Technical Officer A

Developmental Biology Group

Dr. A. Ratnaparkhi, Sci. F
Dr. C. Patra, Sci. D
Dr. B.V. Shravage, Sci. D
M.B. Daware, Technical Officer B
R.J. Londhe, Technical Officer B
A.A. Nikam, Lab. Assistant A

Genetics & Plant Breeding Group

Dr. M.D. Oak, Sci. E
Dr. R.M. Patil, Sci. D
Dr. S.P. Tetali, Sci. D
S.A. Jaybhay, Sci. C
A.M. Chavan, Sci. C
Dr. Y. Kumar K.J., Sci. C
Dr. V.S. Baviskar, Sci. C
Dr. S.P. Nawathe, Sci.B
V.M. Khade, Technical Officer C
V.D. Surve, Technical Officer C
S.P. Karkamkar, Technical Officer B
J.H. Bagwan, Technical Officer B
B.D. Idhol, Technical Officer A
S.V. Phalake, Technical Officer A
V.D. Gite, Technical Officer A
B.N. Waghmare, Technical Officer A
A.A. Deshpande, Technical Officer A
S.S. Khairnar, Technical Assistant B
J.S. Sarode, Lab. Assistant D
D.H. Salunkhe, Lab. Assistant C
D.N. Bankar, Lab. Assistant C
S.L. Bhandalkar, Attendant C
S.R. Kachhi, Attendant C
S.V. Ghadge, Attendant B
D.L. Kolte, Attendant B
T.B. Dhurve, Attendant A
G.S. Rajguru, Attendant A

Nanobioscience Group

Dr. J.M. Rajwade, Sci. E
Dr. D.S. Bodas, Sci. E
Dr. Vandana Ghormade, Sci. E
Dr. Virendra Gajbhiye, Sci. D
Dr. Y.A. Karpe, Sci. D
R.G. Bambe, Technical Officer A
A. Dwivedi, Technical Assistant B
S.S. Waghmare, Lab. Assistant C

Animal House

Dr. S.H. Jadhav, Sci.D
K.V. Tiwari, Attendant B
V.M. Gosavi, Attendant B

Director's Office

Dr. G.K. Wagh, Technical Officer D
Dr. P.P. Apte, Lab. Assistant C
Mr. S.P. Balsane, Attendant A

Administration Section

A. Rahman, Administrative Officer
C.D. Nagpure, Officer B
A.G. Dhongade, Sr. Pvt. Secretary
J.V. Deshpande, Pvt. Secretary
M.B. Tiwari, Officer A
T.V. Kurhade, Assistant A
D.V. Gawade, Assistant A
R.B. Dhobale, Assistant A
R.S. Shinde, Assistant A
S.S. Shah, Assistant A

R.M. Dhandhore, Attendant C
A.B. Kusalkar, Driver
G.H. Agawan, Driver

Accounts Section

S.A. Tembe, Officer B
A.D. Joshi, Officer B
M.C. Ranjane, Assistant B
M.V. Patake, Assistant A
S.S. Chavan, Assistant A
R.G. Birwadkar, Assistant A
S.R. Murade, Assistant A
K.R. Sathe, Attendant B

Stores & Purchase Section

P.V. Gosavi, Stores & Purchase Officer

Purchase

H.N. Mate, Officer B
S.S. Kalekar, Assistant B
A.V. Wable, Assistant A
P.D. Gagare, Assistant A
A.T. Salvi, Attendant C

Store

V.G. Tallu, Officer A
S.A. Shaikh, Assistant A
P.S. Velankar, Assistant A
R.M. Salunke, Attendant D

Engineering Section

A.V. Chaudhari, Technical Officer D
M. Kharade, Technical Officer C
P.V. Sawant, Technical Officer B
D.S. Shinde, Technician B
Nayankumara D., Technician B

Library & Information Centre

R.P. Janrao, Asst. Lib. & Info. Officer
S.A. Deshmukh, Sr. Lib. Assistant
R.R. Kale, Library & Info. Asst.

Appointment

Dr. P.K. Dhakephalkar, Director, 26.3.2021

Promotion

Scientific Staff

Dr. M.D. Oak, Sci. E
Dr. V.Ghormade, Sci. E
Dr. M.N. Datar, Sci. D
Dr. A. Ratnaparkhi, Sci. F

Technical Staff

A.S.Kelkar, Technical Officer C
V.M. Khade, Technical Officer C
R.J. Londhe, Technical Officer B
P.V. Sawant, Technical Officer B
B.N. Waghmare, Technical Officer A
D.K. Mourya, Lab. Assistant D
S.S. Lad, Lab. Assistant D
Nayankumara D., Technician B
V.D. Surve, Technical Officer C
P.G. Gamre, Technical Officer B
A.A. Deshpande, Technical Officer A
R.G. Bambe, Technical Officer A
A. Dwivedi, Technical Assistant B

Ministerial Staff

U. Kulkarnii, Officer B
A.D. Joshi, Officer B

MACP

J.V. Deshpande, Pvt.Secretary
Dr. S.P. Tetali, Scientist D
S.P. Balsane, Attendant A
K.R. Sathe, Attendant B

NTM Staff

R.M. Salunke, Attendant D
S.R. Kachhi, Attendant C
D.L. Kolte, Attendant B

Superannuation

B.A. Kawthekar, Technician D, 30.4.2020
A.D. Patil, Officer A, 31.5.2020
Dr. Philips Verghese, Scientist D, 30.6.2020
V.B. Bhalerao, Officer B, 30.6.2020
P.G. Lavand, Technician A, 30.6.2020

Dr. D. Kshirsagar, Tech Officer C, 31.7.2020

Dr. S.A. Tamhankar, Sci. G, 30.9.2020

V.N. Joshi, Tech Officer A, 30.9.2020

U. Kulkarnii, Officer B, 30.9.2020

S.B. Karanjekar, Attendant D, 31.1.2021

Resignation

S.A. Ashtaputre, Finance & Accounts Officer, 22.5.2020

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 2020-2021

Group	SC	ST	OBC	EWS	General	Total
A	--	--	--	--	01	01
B	--	--	--	--	--	--
C	--	--	--	--	--	--
Total	--	--	–	--	01	01

Emeritus Scientist

Dr. S.M. Ghaskadbi, CSIR Emeritus Scientist

Project Staff

(as on 31.3.2021)

Fellows

Pranitha Pandit, DST-WOS-A

Dr. Madhuri Pawar, SERB-NPDF

Dr. Himanshu, SERB-NPDF

Dr. Kriti Sengupta, SERB-NPDF

Dr. Ritu Mamgain, DST-WOS-A

Dr. Mahesh Y. Borde, SERB-TARE (Botany, SPPU, Pune)

Dr. Bothiraja Chellampillai, SERB-TARE (Poona Coll. Pharmacy)

Dr. J. Asthana, SERB-NPDF

Dr. Garima Misra, DST-WOS-A

Project Scientist - Sponsored Project

Dr. Soham Pore

Research Associate - Sponsored Project

Dr. Nidhi P. Raval

Research Associate - ARI Sponsored Project

Dr. Deepa Shetty

Senior Research Fellow - Sponsored Project

Suhasini Venkatesan

Junior Research Fellow - ARI Project

Kunal Kishor Yadav

Monali S. Kadu

Junior Research Fellow - Sponsored Projects

Mital G. Thacker

Tanvir Rajoddin Shaikh

Minal Sunil Ayachit

Jyoti Arun Mohite

Reshma Jadhav

Manisha Kandroo

Sumit Phakatkar

PriyankaJagdish Pawar

Siddhi K. Chavan

Mangesh S. Rajguru

Tejal Madalkar

Snehal Kulkarni

Shubha Manvi

Shwetali Dambre

Kiran S. Nilangekar

Pranav Joshi

Neeraj Tadasare

Iris George

Shruthi OP

Anagha Basargekar

Geetika Sukharamani

Research Students - ARI Project

Harshita Rana

Sarang A. Bokil

Research Students - Sponsored Project

Kartiki Kadam

Sushen Lomte

Gokul Patil

Technical Assistant- ARI Project

Rutuja Sawant

Ashwini Gund

Amit Gawai

Project Assistant - ARI Project

Bojja Satish

Project Assistant - Sponsored Project

M. Yogeshwaran

Jaserah Syed

Kokila T.

Radhakrishnan Cheran

Purva Sanghvi

Mali - Sponsored Project

Shivaji Parvate

CSIR Senior Research Fellow

Smrithy Vijayan
Kumal Khatri
Nidhi Nirola Murmu
Bhagyashri Joshi
Rameshwar Avchar
Ajay Lagashetty
Nikita Mehta
Pravinkumar Methe
Neha Wadmare
Saurabh Gaikwad

UGC Senior Research Fellow

Bhushan Khairnar
Rajashree Patil
Vaibhav Madiwal
Sonali Kawade
Snigdha Tiwari

CSIR Junior Research Fellow

Pooja Salunke
Snehal Jamalpure
Ganesh Wagh
Payal Deshpande
Malika Suthar
Komal Suryavanshi
Kiran Kharatmal
Mrunmayee Kulkarni
Sayali Rohakale
Ansil P. A.

UGC Junior Research Fellow

Shiwali Rana
Rajesh Salve
Kalyani Deshmukh
(Ms. Kalyani K. Kamble)
Padmaja Anil Shete
KadambariPawar
Sneha H. Deshmukh
Ruchira R. Sutar
Pooja G. Suryavanshi
Tanmayee Sathe
Swapanja Gulani
Prajakta Bhujbal
Tabbasum Nadaf
Karan Selarka
Rohini A. Nangare

DBT Senior Research Fellow

Parimal Vikhe

DBT Junior Research Fellow

Sachin Mapari

DST-INSPIRE Senior Research Fellow

Shraddha Rahi
Sonali Mundhe

DST-INSPIRE Junior Research Fellow

Aishwarya Padhye

ICMR Senior Research Fellow

Neha Kulkarni
Sulaxna Pandey

SARTHI Junior Research Fellow

Bhushan K. Shigwan

PhD students without Fellowship

Kolge Henry Vincent
Anuprita Turwankar
Nikhil D. Ashtekar
Mokshada Varma
Aboli Kulkarni
Amey Rayrikar
Sai Suresh Hivarkar
Satishkumar Maurya
Vigneshwaran A.
Pradnya D. Nagkirti
Kasturi Shrish Deore
Ashwini Darshetkar
Neelam G. Kapse

Audit Report 2020-21

Maharashtra Association for the Cultivation of Science

Auditors Report

We have audited the attached Balance sheet of Maharashtra Association for the Cultivation of Science, Pune as at 31st March, 2021 and the Income and Expenditure Account for the year ended on that date annexed 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 Auditing Standards generally accepted in India & 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 of material misstatements. An Audit includes examining on test basis, evidence supporting the amounts and disclosures in the financial statements. An Audit also includes assessing the accounting principles used and significant estimates made by the management, as well as evaluating the overall financial statements presentation & reporting. We believe that our Audit provides reasonable basis of our opinion.

Subject to above, we report that:

1. We have obtained all the information and explanations, which to the best of our knowledge and belief were necessary for the purpose of our Audit.
2. 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.
3. The Balance Sheet and Income and Expenditure Account dealt with by the report are in agreement with the books of accounts.
4. In our Opinion and to the best of our information and according to the explanations given to us, subject to our comments in annexure to this report, the said accounts give a true and fair view.
   i) In the case of the Balance Sheet, of the state of affairs of the Centre as at 31" March 2021.
   ii) In the case of the Income and Expenditure Account, of the Surplus for the year ended on the date.

As per our report of even date
For **DCRK & ASSOCIATES**
Chartered Accountants
FRN:127831W

Saideep Dhoble Patil
Partner

Place: Pune
Date: 30/07/2021

REPORT OF AN AUDITOR RELATING TO ACCOUNTS AUDITED UNDER SUB-SECTION (2) OF SECTION 33 & 34 AND RULE 19 OF THE BOMBAY PUBLIC TRUSTS ACT

Name of the Public Trust:- MAHARASHTRA ASSOCIATION FOR THE CULTIVATION OF SCIENCE For year ending: 31st March, 2021

Sr. No.	Particulars	Remarks
A	Whether accounts are maintained regularly and in accordance with the provisions of the Act and the rules.	YES
B	Whether receipts and disbursements are properly and correctly shown in the accounts.	YES
C	Whether the cash balance and vouchers in the custody of the manager or trustee on the date of audit were in agreement with the accounts.	YES
D	Whether all books, deeds, accounts, vouchers or other documents records required by the auditor were produced before him.	YES
E	Whether a register of movable and immovable properties is properly maintained, the changes therein are communicated from time to time to the regional office and the defects and inaccuracies mentioned in the previous audit report have been duly complied within.	YES
F	Whether the manager or trustee or any other person required by the auditor to appear before him did so and furnished the necessary information required by him.	YES
G	Whether any property or funds of the Trust were applied for any object or purpose other than the object or purpose of the Trust	NO
H	Whether tenders were invited for repairs or construction involving expenditure exceeding Rs. 5000/	YES
I	Whether any money of the public trust has been invested contrary to the provisions Section 35	NO
J	Alienation, if any of the immovable property contrary to the provisions of Section 36 which have come to the notice of the auditor.	NO
K	All cases of irregular, illegal or improper expenditure or failure or omission to recover monies or other property belonging to the public trust or of loss or waste of money or other property thereof and whether such expenditure, failure, omission loss or waste was caused in consequence of breach of trust or misapplication or any other misconduct on the part of the trustees or any other person while in the management of the trust.	NO
L	Whether the minutes books of the proceedings of the meeting is maintained.	YES
M	Whether any of the trustees has any interest in the investment of the trust.	NO
N	Whether the irregularities pointed out by the auditors in the accounts of the previous year have been duly complied with by the trustees during the period of audit.	YES
O	Any special matter which the auditor may think fit or necessary to bring to the notice of the Deputy or Assistant Charity Commissioner	NO

As per our report of even date
For **DCRK & ASSOCIATES**
Chartered Accountants
FRN:127831W

Saideep Dhoble Patil
Partner

Place: Pune
Date: 30/07/2021

MAHARASHTRA ASSOCIATION FOR THE CULTIVATION OF SCIENCE: PUNE - 411 004.

Balance Sheet as on 31.03.2021

Amount - Rs.

FUNDS AND LIABILITIES	SCH.	CURRENT YEAR	PREVIOUS YEAR
CAPITAL ACCOUNTS	**A**	1,07,61,721	1,07,61,721
CURRENT LIABILITIES	**B**	37,72,987	27,26,828
INCOME & EXP.A/C		1,73,19,105	1,69,65,088
(Sub Schedule 4)			
TOTAL		**3,18,53,813**	**3,04,53,637**

PROPERTY AND ASSETS	SCH.	CURRENT YEAR	PREVIOUS YEAR
FIXED ASSETS	**C**	92,50,932	92,58,897
INVESTMENTS	**D**	1,81,93,436	1,71,05,429
DEPOSITS & ADVANCES	**E**	38,31,628	27,31,652
CASH & BANK BALANCES	**F**	5,77,816	13,57,659
TOTAL		**3,18,53,813**	**3,04,53,637**

The above Balance Sheet to the best of our knowledge and belief contains a true account of the Funds, Liabilities and of the Property and Assets of the Association.

As per our report of even date
For **DCRK & ASSOCIATES**
Chartered Accountants
FRN:127831W

HON. F.& A.O.	**HON. Treasurer**	**HON. Secretary**	**Saideep Dhoble Patil**
M.A.C.S.	M.A.C.S.	M.A.C.S.	Partner

Place: Pune
Date: 30/07/2021

MAHARASHTRA ASSOCIATION FOR THE CULTIVATION OF SCIENCE: PUNE - 411 004

Income and Expenditure Account for the Year Ended on 31.03.2021

Amount - Rs.

EXPENDITURE	CURRENT YEAR	PREVIOUS YEAR	INCOME	CURRENT YEAR	PREVIOUS YEAR
Depreciation : Immovable Properties (By way of provision or adjustment)	2,965	2,965	Interest (Realised)		
			On S.B. A/c	99,824	95,748
			On Investments	10,30,692	7,20,469
Establishment Expenses (As per Schedule H)	1,95,796	2,69,851	Donation	-	-
Audit fees	3,540	3,540	Income from other Sources (As per Schedule L)	500	2,16,000
Legal Fees	-	36,000			
Professional fees	-	5,000	Income tax refund received (Interest)	-	2,25,877
Depreciation : Furniture & Dead Stock	19,699	73,927			
Expenditure on the object of The Trust (As per Schedule I)	5,55,000	7,28,752			
Surplus carried over to Balance sheet	3,54,016	1,38,058			
TOTAL	**11,31,016**	**12,58,094**	**TOTAL**	**11,31,016**	**12,58,094**

We hereby certify that the above income and Expenditure Account is correct to the best of our knowledge and belief.

As per our report of even date
For **DCRK & ASSOCIATES**
Chartered Accountants
FRN:127831W

HON. F.& A.O.	**HON. Treasurer**	**HON. Secretary**	**Saideep Dhoble Patil**
M.A.C.S.	M.A.C.S.	M.A.C.S.	Partner

Place: Pune
Date: 30/07/2021

MAHARASHTRA ASSOCIATION FOR THE CULTIVATION OF SCIENCE: PUNE - 411 004

Statement of Receipts & Payments for the Year Ended on 31.03.2021

Amount - Rs.

RECEIPTS	SCH.	CURRENT YEAR	PREVIOUS YEAR	PAYMENTS	SCH.	CURRENT YEAR	PREVIOUS YEAR
Opening Balances	**F**	13,57,660	14,33,074	Establishment Expenses	**H**	1,94,955	1,81,107
Interest Received				Expenditure on Object of Trust	**K**	5,000	80,638
On Savings Bank A/c		99,824	95,748				
Interest on Investments		1,17,049	10,28,703	Audit Fees & Creditors		5,62,621	7,30,529
Encashment of Fixed Deposit		7,00,000	1,11,04,819	Income tax refund paid share of ARI & Scheme		-	20,29,362
Income tax refund received with interest		-	24,04,046	Legal Fees		-	36,000
				Professional fees		-	5,000
Donation Received				Fixed Deposit with Banks		8,79,640	1,19,08,180
C.M. Relief Fund		-	1,000	Indirect Receipt & Payment	**J**	29,57,10,892	21,67,42,073
Income from Other Sources	**G**	500	2,16,000	Closing Balances	**F**	5,77,817	13,57,660
Indirect Receipt & Payment	**J**	29,56,55,892	21,67,87,159				
TOTAL		**29,79,30,925**	**23,30,70,549**	**TOTAL**		**29,79,30,925**	**23,30,70,549**

We hereby certify that the aforesaid statement to be true and correct to the best of our knowledge and belief.

As per our report of even date
For **DCRK & ASSOCIATES**
Chartered Accountants
FRN:127831W

HON. F.& A.O.	**HON. Treasurer**	**HON. Secretary**	**Saideep Dhoble Patil**
M.A.C.S.	M.A.C.S.	M.A.C.S.	Partner

Place: Pune
Date: 30/07/2021

MAHARASHTRA ASSOCIATION FOR THE CULTIVATION OF SCIENCE: PUNE-411 004

Schedules to and forming part of Balance sheet as on 31.03.2021

Schedule "A" : Capital Account

Amount - Rs.

PARTICULARS	SUB-SCH	CURRENT YEAR	PREVIOUS YEAR
TRUST FUND OR CORPUS	1	1,03,77,874	1,03,77,874
OTHER EARMARKED FUNDS	2	3,83,847	3,83,847
TOTAL(RS.)		**1,07,61,721**	**1,07,61,721**

Schedule "B" : Current Liabilities

Amount - Rs.

PARTICULARS	SUB-SCH	CURRENT YEAR	PREVIOUS YEAR
OTHER LIABILITIES	3	37,72,987	27,26,828
TOTAL(RS.)		**37,72,987**	**27,26,828**

Schedule "C" : Fixed Assets

Amount - Rs.

PARTICULARS	SUB-SCH	CURRENT YEAR	PREVIOUS YEAR
IMMOVABLE PROPERTIES	5	91,26,479	91,29,444
FURNITURE AND DEAD STOCK	6	1,24,453	1,29,453
TOTAL(RS.)		**92,50,932**	**92,58,897**

MAHARASHTRA ASSOCIATION FOR THE CULTIVATION OF SCIENCE: PUNE-411 004

Schedules to and forming part of Balance sheet as on 31.03.2021

Schedule "D" : Investments

Amount - Rs.

Sr. No.	Name of the Company	Particulars	Date of Investment	Date of maturity	Current Year	Previous Year
	SHARES				1325	1325
1	Central Potteries Ltd.	Share of Rs. 25 each				
	Nagpur	Certificate No.1343 bearing Sr.No.29114 to 29126 13 ordinary	21.01.1949			
		Certificate No. 551 bearing Sr.No. 3717 to 3756 40 ordinary	10.06.1940			
2	HINDUSTAN MOTORS LTD.	Shares of Rs. 10 each 50 ordinary	-	-	500	500
		Share certificate No.33932				
		bearing Sr. No.4632651-4632700				
	FIXED DEPOSITS					
1	BANK OF MAHARASHTRA	60307790389	24.05.2018	24.05.2020	*	5,00,000
		60088467793	30.12.2017	30.12.2021	3,00,000	3,00,000
		60088467534	30.12.2017	30.12.2021	3,00,000	3,00,000
		60126451909	01.03.2020	31.03.2020	*	2,00,000
2	INDIAN BANK	6019228988	03.03.2021	29.02.2024	10,32,625	8,57,788
		6019228671	03.03.2021	29.02.2024	10,32,625	8,57,788
		6056528884	03.08.2018	31.07.2021	2,00,000	2,00,000
4	BANK OF INDIA	50345110007246 **	24.11.2020	24.11.2022	19,56,108	19,79,848
5	HDFC	50300352429665	09.07.2020	10.07.2021	67,83,435	63,08,180
		50300377850429	25.10.2019	26.10.2021	10,00,000	10,00,000
		50300381999484	11.11.2019	12.11.2021	17,00,000	17,00,000
		50300403645600	11.02.2020	12.02.2022	4,00,000	4,00,000
		50300405767617	24.02.2020	25.02.2022	5,00,000	5,00,000
		50300405767962	24.02.2020	25.02.2022	10,00,000	10,00,000
		50300417029245	08.04.2020	09.04.2022	2,00,000	-
		50300437838952	12.06.2020	13.06.2022	5,69,640	-
		50300417031045	08.04.2020	09.04.2022	1,10,000	-
6	IDFC	10053500553	27.02.2021	11.07.2021	11,07,178	10,00,000
	GRAND TOTAL				**1,81,93,436**	**1,71,05,429**

*Fixed Deposit closed and transferred to **HDFC**

**Maturity amount was taken in F.Y 2019-20 which is changed to principal amount in F.Y 2020-21 (difference is TDS deducted on maturity amount)

MAHARASHTRA ASSOCIATION FOR THE CULTIVATION OF SCIENCE: PUNE - 411 004

Schedules to and forming part of Balance sheet as on 31.03.2021

Schedule "E" : Deposits & Advances

Amount - Rs.

PARTICULARS	CURRENT YEAR		PREVIOUS YEAR	
DEPOSITS :				
Telephone Deposit	10,000		10,000	
Deposit with Court	15,000	25,000	15,000	25,000
ADVANCES :				
Advance to Staff	-		5,000	
Income Tax Deducted at Source	35,65,573	35,65,573	24,51,120	24,56,120
Interest accrued on Investments				
(Subject to confirmation from bank & other agencies)				
As per last Balance Sheet	2,50,532		5,97,273	
Less Realised during the year	1,84,314		4,56,017	
	66,218		1,41,256	
Accrued Interest during the year	1,74,837	2,41,055	1,09,276	2,50,532
TOTAL Rs.		**38,31,628**		**27,31,652**

Schedule "F" : Cash & Bank Balances

Amount - Rs.

PARTICULARS	CURRENT YEAR		PREVIOUS YEAR	
	OPENING BALANCE	CLOSING BALANCE	OPENING BALANCE	CLOSING BALANCE
CASH IN HAND	10,647	4,798	19,356	10,647
BANK :				
With Bank of Maharashtra Erandwana Branch in Savings A/c No.9709	10,14,710	2,71,624	12,54,208	10,14,710
With Union Bank of India, F.C. Road Branch in S.B. A/c 48941261091951	2,20,446	3,00,850	1,59,509	2,20,446
With HDFC Saving BK A/C NO.50100304122670	1,11,857	545	-	1,11,857
TOTAL (RS.)	**14,33,074**	**5,77,816**	**14,33,074**	**13,57,659**

MAHARASHTRA ASSOCIATION FOR THE CULTIVATION OF SCIENCE: PUNE - 411 004

Schedules to and forming part of Statement of Receipts & Payments
and Income & Expenditure Account for the year ended on 31.03.2021

Schedule"G" : Income From Other Sources

Amount - Rs.

PARTICULARS	CURRENT YEAR		PREVIOUS YEAR	
	INCOME & EXP. ACCOUNT	RECEIPT & PAYMENT ACCOUNT	INCOME & EXP. ACCOUNT	RECEIPT & PAYMENT ACCOUNT
Fee for Home Gardening course	-	-	1,98,000	1,98,000
Claim received against loss due to flood	-	-	16,000	16,000
Life Membership Fees	500	500	2,000	2,000
TOTAL (RS.)	**500**	**500**	**2,16,000**	**2,16,000**

Schedule "H" : Establishment Expenses

Amount - Rs.

PARTICULARS	CURRENT YEAR		PREVIOUS YEAR	
	INCOME & EXP. ACCOUNT	RECEIPT & PAYMENT ACCOUNT	INCOME & EXP. ACCOUNT	RECEIPT & PAYMENT ACCOUNT
Honorarium to Staff	1,74,422	1,74,422	1,62,035	1,62,035
Meeting Expenses	5,849	5,849	4,287	4,287
Miscellaneous Expenses	-	-	73,315	5,900
Hospitality Expenses	-	-	5,347	5,347
Travelling & Conveyance	3,150	3,150	11,901	312
Printing & Stationery	3,361	2,520	4,405	2,540
Advertisement charges	7,875	7,875	7,875	-
Bank charges	1,139	1,139	686	686
TOTAL (RS.)	**1,95,796**	**1,94,955**	**2,69,851**	**1,81,107**

MAHARASHTRA ASSOCIATION FOR THE CULTIVATION OF SCIENCE: PUNE - 411 004

Schedules forming part of Receipt & Payment Account for the year ended on 31.03.2021

Schedule "I" : Expenditure on the Object of the Trust

Amount - Rs.

PARTICULARS	CURRENT YEAR	PREVIOUS YEAR
Expenditure out of Earmarked Donations		
Prof. V.P. Gokhale Award Expenses	-	5,000
Dr. R.B. Ekbote Award Expenses	-	5,000
Dr. A.D. Agate Award Expenses	2,500	2,500
Donation Expenses Prof. P.V. Sukhatme	2,500	2,500
Prof. S.P. Agharkar Chair Expenses	5,50,000	6,00,000
Home Garden Course Expenses	-	78,552
Smt. Parvatibai Agharkar Fellowship Award	-	35,200
TOTAL (RS.)	**5,55,000**	**7,28,752**

Schedule "J" : Indirect Receipts & Payments

Amount - Rs.

PARTICULARS	CURRENT YEAR		PREVIOUS YEAR	
	RECEIPTS	PAYMENTS	RECEIPTS	PAYMENTS
ARI Account	29,50,00,000	29,50,00,000	21,09,14,000	21,09,14,000
Schemes Account	6,48,892	6,48,892	56,91,073	56,91,073
Advance to staff	7,000	2,000	48,886	77,000
TDS Professional fees & Contractor	-	60,000	3,600	60,000
Testing fees (Smartchem Tech)	-	-	1,29,600	-
TOTAL	**29,56,55,892**	**29,57,10,892**	**21,67,87,159**	**21,67,42,073**

MAHARASHTRA ASSOCIATION FOR THE CULTIVATION OF SCIENCE: PUNE - 411 004

Schedules to and forming part of Receipts & Payments for the year ended on 31.03.2021

Schedule "K" : Expenditure on the Object of the Trust

Amount - Rs.

PARTICULARS	CURRENT YEAR	PREVIOUS YEAR
Expenditure out of Earmerked Donations		
Prof. V.P. Gokhale Award Expenses	-	5,000
Dr. R.B. Ekbote Award Expenses	-	5,000
A. D. Agate Award Expenses	2,500	2,500
Yogamaya Award Expenses	-	-
Donation Expenses Prof. P.V. Sukhatme	2,500	2,500
Prof. S.P. Agharkar Chair Expenses	-	-
Home Garden Course Expenses	-	30,438
Smt. Parvatibai Agharkar fellowship award	-	35,200
TOTAL (RS.)	**5,000**	**80,638**

Schedule"L" : Income From Other Sources

Amount - Rs.

PARTICULARS	CURRENT YEAR	PREVIOUS YEAR
Fee for Home Gardening Course	-	1,98,000
Claim received against loss due to flood	-	16,000
Life Membership Fees	500	2,000
TOTAL (RS.)	**500**	**2,16,000**

As per our report of even date
For **DCRK & ASSOCIATES**
Chartered Accountants
FRN:127831W

HON. F.& A.O.	**HON. Treasurer**	**HON. Secretary**	**Saideep Dhoble Patil**
M.A.C.S.	M.A.C.S.	M.A.C.S.	Partner

Place: Pune
Date: 30/07/2021

MAHARASHTRA ASSOCIATION FOR THE CULTIVATION OF SCIENCE: PUNE - 411 004

Schedules to and forming part of Balance Sheet as on 31.03.2021

Sub Schedule "1" Trust Fund or Corpus

Amount - Rs.

PARTICULARS	CURRENT YEAR	PREVIOUS YEAR
Trust/Corpus Fund	1,03,77,874	1,03,77,874
TOTAL(RS.)	**1,03,77,874**	**1,03,77,874**

Sub Schedule "2" Other Earmarked Funds

Amount - Rs.

PARTICULARS	CURRENT YEAR	PREVIOUS YEAR
Reserve Fund (Created vide resolution No. 16 dated 12.4.1984)	36,926	36,926
Museum Fund (As per Last Balance Sheet)	888	888
Prof. S.P. Agharkar Fund (As per Last Balance Sheet)	14,000	14,000
Prof. S.P. Agharkar Birth Centenary Fund (As per last Balance Sheet)	3,32,033	3,32,033
TOTAL (RS.)	**3,83,847**	**3,83,847**

Sub Schedule "3" Other Liabilities

Amount - Rs.

PARTICULARS	CURRENT YEAR	PREVIOUS YEAR
Audit fees payable	3,540	7,080
Medclin Research Pvt. Ltd	2,70,992	2,70,992
TDS Payable	34,98,455	24,03,756
Sundry Creditors	-	45,000
TOTAL (RS.)	**37,72,987**	**27,26,828**

Sub Schedule "4" Income & Expenditure Account

Amount - Rs.

PARTICULARS	CURRENT YEAR		PREVIOUS YEAR	
Opening Balance	1,69,65,088		1,68,27,030	
Surplus carried over to Balance sheet	3,54,016		1,38,058	
		1,73,19,104		1,69,65,088
TOTAL (RS.)		**1,73,19,104**		**1,69,65,088**

MAHARASHTRA ASSOCIATION FOR THE CULTIVATION OF SCIENCE: PUNE - 411 004

Schedules to and forming part of Balance Sheet as on 31.03.2021

Sub Schedule "5" : Immovable Properties

Amount - Rs.

SR No	Particulars	Rate of Depreciation	GROSS BLOCK			DEPRECIATION BLOCK					WDV as on 31.03.2021
			Cost as on 01.04.20	Additions during the year	Total Cost as on 31.03.2021	Up to 31.3.2020	Dep. On opening Balance	Dep. On the Additions during the year	Total Dep.for the Year	Total as on 31.03.2021	
1	Land at Pune		96,500	-	96,500	-	-	-	-	-	96,500
2	Land at Songaon		88,19,437	-	88,19,437	-	-	-	-	-	88,19,437
3	Land Development Expenses at Hol		2,02,583	-	2,02,583	-	-	-	-	-	2,02,583
4	Biometry Building	2.50%	1,15,200	-	1,15,200	1,04,509	2,880	-	2,880	1,07,389	7,811
5	Microbiology Building	2.50%	3,389	-	3,389	3,156	85	-	85	3,241	148
	TOTAL (RS.)		**92,37,109**	**-**	**92,37,109**	**1,07,665**	**2,965**	**-**	**2,965**	**1,10,630**	**91,26,479**

Sub Schedule "6" : Furniture and Dead Stock

Amount - Rs.

PARTICULARS	GROSS BLOCK			DEPRECIATION BLOCK						
	Cost as on 1.4.2020	Additions during the year	Total cost as on 31.03.2021	Rate of Depreciation	Up to 31.3.2020	Dep. On opening Balance	Dep. On the Additions during the year	Total Dep. for the Year	Total as on 31.03.2021	WDV as on 31.03.2021
1	2	3	4	5	6	7	8	9	10	11
A) (I) GENERAL										
1. Office Equipment's & Furniture & Sports Items	6,04,287	14,700	6,18,987	10%	5,88,509	15,777	1,470	17,247	6,05,756	13,231
2. Apparatus & Equipment's	3,15,076	-	3,15,076	20%	2,89,836	-	-	-	2,89,836	25,240
3. Electric Fittings	9,870	-	9,870	10%	9,869	-	-	-	9,869	1

Amount - Rs.

PARTICULARS	GROSS BLOCK			DEPRECIATION BLOCK						
	Cost as on 1.4.2020	Additions during the year	Total cost as on 31.03.2021	Rate of Depreciation	Up to 31.3.2020	Dep. On opening Balance	Dep. On the Additions during the year	Total Dep. for the Year	Total as on 31.03.2021	WDV as on 31.03.2021
1	2	3	4	5	6	7	8	9	10	11
4. Books	1,19,522	-	1,19,522	20%	1,16,442	-	-	-	1,16,442	3,080
5. Y -Type System for Grapes-Hol	1,10,497	-	1,10,497	10%	1,10,496	-	-	-	1,10,496	1
6. Construction of Statue	98,090	-	98,090	2.5%	17,164	2,452	-	2,452	19,616	78,474
SUB TOTAL (A)(I)	**12,57,342**	**-**	**12,72,042**		**11,32,316**	**18,229**	**1,470**	**19,699**	**11,52,015**	**1,20,027**
A) (II) SPECIAL PUBLICATIONS										
1. Marathi Publication by Prof. M.N. Kamat (Cost of Rs. 1.54)	4,428	-	4,428	0%	2,367	-	-	-	2,367	2,061
2. Enumeration of Plants from Gomantak by Dr. V.D. Vartak (Cost of Rs. 3.60)	3,154	-	3,154	0%	1,100	-	-	-	1,100	2,054
SUB-TOTAL (A)(II)	7,582	-	**7,582**	**0%**	**3,467**	**-**	**-**	**-**	**3,467**	**4,115**
TOTAL A (I+II)	**12,64,924**	**-**	**12,79,624**	**0%**	**11,35,783**	**18,229**	**1,470**	**19,699**	**11,55,482**	**1,24,142**
B) UNIVERSITY OF PUNE										
1. Office Equipment & Furniture	1,300	-	1,300	0%	1,242	-	-	-	1,242	58
2. Books	25,538	-	25,538	0%	25,341	-	-	-	25,341	197
3. Aparatus & Equipments	9,914	-	9,914	0%	9,891	-	-	-	9,891	23
TOTAL (B)	**36,752**	**-**	**36,752**	**0%**	**36,474**	**-**	**-**	**-**	**36,474**	**278**
C) GOVT.OF MAHARASHTRA										
1. Office Equipment & Furniture	1,008	-	1,008	10%	993	-	-	-	993	15
2. Apparatus & Equipments	21,363	-	21,363	20%	21,345	-	-	-	21,345	18
3. Books	1,210	-	1,210	20%	1,209	-	-	-	1,209	1
TOTAL (C)	**23,581**	-	**23,581**		**23,547**	**-**	**-**	**-**	**23,547**	**34**
GRAND TOTAL (A+B+C)	**13,25,257**	**-**	**13,39,957**		**11,95,804**	**18,229**	**1,470**	**19,699**	**12,15,503**	**1,24,453**

Agharkar Research Institute of Maharashtra Association for the Cultivation of Science

Auditor's Report

We have audited the attached Balance Sheet of **Agharkar Research Institute of Maharashtra association for the Cultivation of Science**, situated at Gopal Ganesh Agharkar Road, Pune as at 31 March, 2021 and Income and Expenditure Account for the year ended on that date annexed to."There is no serious irregularities appear to be observed by the Auditor while auditing the annual accounts in the Annual Report 2020-21 as per Auditors observation/Report".

These Financial statements are the responsibility of the Institute's management. Our responsibility is to express an opinion on these financial statements based on our Audit. We conducted our Audit in accordance with Auditing Standards generally accepted in India & Provisions of Bombay Public Trust Act, 1950. Those standards require that we plan and perform the Audit to obtain reasonable assurance about whether the financial statements are free of material misstatements. An Audit includes examining on a test basis, evidence supporting the amounts and disclosures in the financial statements. An Audit also includes assessing the accounting principles used and significant estimates made by the management, as well as evaluating the overall financial statement presentation & reporting. We believe that our Audit provides a reasonable basis for our opinion.

Emphasis of Matter

We draw your attention to following matter.

1. Fixed Assets and Closing Stock as on 31 " March, 2021 has been included in the financial statements as taken, 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 Fixed Assets and Closing Stock certified by the management.

Subject to above, we report that:

1. We have obtained all the information and explanations, which to the best of our knowledge and belief were necessary for the purpose of our Audit.
2. 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.
3. The Balance Sheet, Income and Expenditure Account and the Receipts and Payments Account dealt with by the report are in agreement with the books of accounts.
4. In our opinion and to the best of our information and according to the explanations given to us. subject to our comments in annexure to this report, the said accounts give a true and fair view.

i) In the case of the Balance Sheet, of the state of affairs of the Centre as at 31st, March 2021.

ii) In the case of the Income and Expenditure Account of the Deficit for the year ended on the date.

5. In our opinion, the Balance sheet & Income & 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 Standards - 5 "Net Profit or Loss for the Period, Prior Period items and changes in Accounting Policies", Accounting Standards - 11 "The effects of changes in Foreign Exchange Rate", Accounting Standards - 12 Accounting for Government Grants". Exceptions can be referred to Significant Accounting Policies & Notes to Account followed by the Institute and impact of the same on Financial Statement cannot be quantified.

6. There is no separate Corpus Fund created by the institute. The balance of Income Expenditure i.e Surplus/Deficit is transferred to Corpus/Capital Fund Schedule.

As per our report of even date
For **DCRK & ASSOCIATES**
Chartered Accountants
FRN:127831W

Saideep Dhoble Patil
Partner

Place: Pune
Date: 30/07/2021

M.A.C.S'S AGHARKAR RESEARCH INSTITUTE, PUNE - 411 004

Balance Sheet as on 31.03.2021

Amount - Rs.

Particulars	Sch	Current Year	Previous Year
CORPUS/CAPITAL FUND AND LIABILITIES:			
CAPITAL FUND	1	8,86,00,123	9,60,79,363
RESERVES AND SURPLUS	2	-	-
EARMARKED/ENDOWMENT FUNDS	3	18,15,41,572	16,48,04,811
SECURED LOANS AND BORROWINGS	4	-	-
UNSECURED LOANS AND BORROWINGS	5	-	-
DEFERRED CREDIT LIABILITIES	6	-	-
CURRENT LIABILITIES AND PROVISIONS	7	22,80,13,671	17,26,62,277
TOTAL		**49,81,55,366**	**43,35,46,451**
ASSETS:			
FIXED ASSETS	8	20,58,59,651	19,78,88,888
INVESTMENTS-FROM EARMARKED/ENDOWMENT FUNDS	9	10,34,92,360	10,08,48,939
INVESTMENTS-OTHERS	10	-	-
CURRENT ASSETS, LOANS, ADVANCES ETC.	11	18,88,03,355	13,48,08,624
MISCELLANEOUS EXPENDITURES (to the extent not written off or adjusted)			
TOTAL		**49,81,55,366**	**43,35,46,451**
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 **DCRK & ASSOCIATES**
Chartered Accountants
FRN:127831W

Saideep Dhoble Patil
Partner

Sd/-
FINANCE & ACCOUNTS OFFICER
MACS ARI

Sd/-
DIRECTOR
MACS ARI, PUNE

Place: Pune
Date: 30/07/2021

M.A.C.S'S AGHARKAR RESEARCH INSTITUTE, PUNE - 411 004

Income & Expenditure Account for the Year ended 31.03.2021

Amount - Rs.

Particulars	Sch	Current Year	Previous Year
Income			
Income from Sales/Services	12	17,00,338	29,87,451
Grants/Subsidies	13	25,18,26,895	20,45,79,378
Fees/Subscriptions	14	2,61,920	8,11,569
Income from Investments(Income on Invest. From earmarked/endowment Funds transferred to Funds)	15	-	-
Income from Royalty, Publications etc.	16	-	31,260
Interest Earned	17	11,79,688	24,43,071
Other Income	18	9,02,032	9,79,254
Increase/(decrease) in stock of Laboratory consumables	19	(23,679)	(76,328)
Donation Received in kind (Equipment)		-	-
Total (A)		**25,58,47,194**	**21,17,55,655**
Expenditure			
Establishment Expenses	20	24,09,14,164	17,91,15,592
Other Administrative Expenses etc.	21	3,64,65,727	4,57,92,666
Expenditure on Grants, Subsidies etc.	22	-	-
Interest	23	-	-
Depreciation (Net Total at the year-end- corresponding to schedule 8)	8	1,13,25,137	89,03,530
Total (B)		**28,87,05,028**	**23,38,11,788**
Balance being excess of Income over Expenditure (A-B)		(3,28,57,834)	(2,20,56,133)
CORPUS/CAPITAL FUND		**(3,28,57,834)**	**(2,20,56,133)**
SIGNIFICANT ACCOUNTING POLICIES	24		
CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS	25		

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 **DCRK & ASSOCIATES**
Chartered Accountants
FRN:127831W

Saideep Dhoble Patil
Partner

Sd/-
FINANCE & ACCOUNTS OFFICER
MACS ARI

Sd/-
DIRECTOR
MACS ARI, PUNE

Place: Pune
Date: 30/07/2021

M.A.C.S'S AGHARKAR RESEARCH INSTITUTE, PUNE - 411 004

Schedules Forming Part of Balance Sheet as at 31.03.2021

Schedule 1: Corpus/Capital Fund

Amount - Rs.

Particulars	Current Year		Previous Year	
Corpus Fund	-		-	
Capital Fund				
Balance as the beginning of the year	6,10,53,316		7,79,08,146	
Add : Contributions towards Corpus/Capital Fund (Schedule D)	3,39,59,959		52,01,303	
Add/ (Deduct) : Balance of Net Income/ (Expenditure)	(3,28,57,834)	6,21,55,441	(2,20,56,133)	6,10,53,316
Capital Fund				
Balance as the beginning of the year	3,50,26,047		1,96,63,217	
Add: Capital Grant during the year	2,50,00,000		2,18,63,000	
Add: Interest Earned F.Y 2020-21 (Cap)	6,34,678		2,56,084	
Less: Interest Paid F.Y 2019-20 (Cap)	2,56,084		15,54,951	
Less: Expenditure during the year	3,39,59,959		52,01,303	
		2,64,44,682		3,50,26,047
Balance at the end of the year		**8,86,00,123**		**9,60,79,363**

Schedule 2: Reserves & Surplus

Amount - Rs.

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

* Interest earned on capital payable to DST

** There is no separate Corpus Fund created by the institute. The balance of Income Expenditure i.e Surplus/Deficit & Equipment Purchase During the year is transferred to Capital Fund Schedule.

MAHARASHTRA ASSOCIATION FOR THE CULTIVATION OF SCIENCE: PUNE - 411 004

Schedules Forming Part of Balance Sheet as at 31.03.2021

Schedule 3 : Earmarked/Endowment Funds

Amount - Rs.

PARTICULARS	FUND-WISE BREAK UP				TOTALS	
	Lab. Res. Fund (Tech.Dev.Fund)	Dr. A. B. Joshi	Dr. A. D. Agate	Welfare fund	Current Year	Previous Year
a> Opening balance of the funds	10,06,34,941	7,12,479	2,060	1,26,939	10,14,76,419	8,20,75,977
b> Additions to the funds:	-	-	-	-	-	-
i) Donations/grants	-	-	-	-	-	-
ii) Income from investments made on account of funds.	53,34,083	16,252	-	-	53,50,335	43,48,249
iii) Culture Identification Charges	-	-	-	-	-	-
iv) Overhead Charges from Scheme	37,10,420	-	-	-	37,10,420	55,19,865
v) Interest received on Funds from various projects	-	-	-	-	-	-
vi) Other Misc.	83,78,913	-	-	-	83,78,913	95,32,328
TOTAL (a+b)	**11,80,58,357**	**7,28,731**	**2,060**	**1,26,939**	**11,89,16,087**	**10,14,76,419**
c> Utilisation/Expenditure towards objectives of funds	-	-	-	-	-	-
i> Capital Expenditure	-	-	-	-	-	-
Fixed Assets	-	-	-	-	-	-
Others	-	-	-	-	-	-
ii> Revenue Expenditure	-	-	-	-	-	-
Salaries, Wages and allowances etc.	-	-	-	-	-	-
Rent	-				-	-
Other Administrative Expense	8,67,344	-	-	-	8,67,344	-
TOTAL (c)	**8,67,344**	**-**	**-**	**-**	**8,67,344**	**-**
NET BALANCE AS AT THE YEAR-END (a+b-c)	**11,71,91,013**	**7,28,731**	**2,060**	**1,26,939**	**11,80,48,743**	**10,14,76,419**
Add: Balance as per Schedule 3A	-	-	-	-	6,34,92,829	6,33,28,391
Total Balance as on 31.3.2021	**11,71,91,013**	**7,28,731**	**2,060**	**1,26,939**	**18,15,41,572**	**16,48,04,811**

M.A.C.S'S AGHARKAR RESEARCH INSTITUTE, PUNE - 411 004

Schedules Forming Part of Balance Sheet as at 31.03.2021

Schedule "3-A" : Unspent Balance of Scheme-Grant

Amount - Rs.

SR. NO.	PATICULARS	OPENING BALANCE		DURING THE YEAR		CLOSING BALANCE	
		DEBIT	CREDIT	DEBIT	CREDIT	DEBIT	CREDIT
1	S/APL/SP 303- Dr. S.K. Singh	-	6,28,543	2,30,544	4,39,111	-	8,37,110
2	S/ARP ENVIRONMENT	-	7,892	-	-	-	7,892
3	S/Biome Tech/SP-308- Mr. P.R. Kshirsagar	-	80,000	2,29,862	2,00,123	-	50,261
4	S/CSIR/ Leather Additional COMP	800	-	-	-	800	-
5	S/CSIR/SP 271- Dr. Yogesh Karpe	-	6,116	-	-	-	6,116
6	S/CSIR/SP 272- Dr. K.G. Kulkarni	-	52,303	58,548	-	6,245	-
7	S/DBT/ SP 185	1,71,438	-	-	-	1,71,438	-
8	S/DBT/SP 188- Dr. Ghaskadbi	2,41,502	-	-	-	2,41,502	-
9	S/ DBT/SP 189- Dr. Ghaskadbi	-	17,479	-	-	-	17,479
10	S/DBT/SP 199	60,303	-	-	-	60,303	-
11	S/DBT/SP 207- Dr. Behera	-	14,32,670	4,56,970	-	-	9,75,700
12	S/DBT/SP 234- Dr. Paknikar/ Dr. Ghormade	-	2,20,459	-	-	-	2,20,459
13	S/DBT/SP 238- Dr. Manoj Oak	-	1,00,021	-	-	-	1,00,021
14	S/DBT/SP 250- Dr. Varghese	-	92,309	3,51,935	2,99,651	-	40,025
15	S/DBT/SP 256- Dr. Shravage	-	71,693	4,25,090	4,43,131	-	89,734
16	S/DBT/SP- 270- Dr. Yogesh Karpe	-	3,17,677	1,28,277	11,535	-	2,00,935
17	S/DBT/SP 275- Dr. Anupama Engineer	-	4,35,426	4,39,386	3,960	-	-
18	S/DBT/SP 276- Dr. Sumit Dagar	-	2,51,155	11,08,859	13,97,921	-	5,40,217
19	S/DBT/SP 278- Dr. Shravage	-	1,46,185	11,03,136	10,72,088	-	1,15,137
20	S/DBT/SP 280- Dr. Ratnaparkhi	-	10,78,076	15,10,073	11,59,717	-	7,27,720
21	S/DBT/SP 281- Dr. Tamhankar	-	2,14,693	7,47,567	8,63,251	-	3,30,377
22	S/DBT/SP 282- Dr. Karthick B.	-	1,48,374	17,73,457	18,79,058	-	2,53,975
23	S/DBT/SP 293- Dr. S.A. Tamhankar	-	28,11,232	7,75,266	6,72,404	-	27,08,370
24	S/DBT/SP 297- Dr. Chinmoy Patra	-	23,07,686	27,05,578	97,805	3,00,087	-
25	S/DBT/SP 300- Dr. J.M. Rajwade	-	36,47,571	26,77,994	87,308	-	10,56,885
26	S/DBT/SP 310- Dr. Yashavanthakumar	-	2,50,000	2,43,705	6,613	-	12,908
27	S/DBT/SP 323- Dr. Vandana Ghormade	-	-	58,000	11,25,218	-	10,67,218
28	S/DBT/ SP 70	-	242	-	-	-	242
29	S/DBT/Wheat Molecular Seminar	-	976	-	-	-	976
30	S/DST/ANAEMIA Workshop	-	91,595	-	-	-	91,595
31	S/DST/GLV Meeting	-	11,845	-	-	-	11,845
32	S/DST Inspire/SP 228 Dr. Anjali Jha	51,676	-	3,54,613	4,06,289	-	-
33	S/DST/SP 239A- Dr. Patra	9,48,791	-	31,501	9,80,292	-	-
34	S/ DST/SP 255- Dr. Rajwade	-	2,44,755	-	-	-	2,44,755
35	S/DST/SP 261- Dr. Gajbhiye	-	75,433	2,16,696	2,00,000	-	58,737
36	S/DST/SP 263- Dr. Yogesh Karpe	-	55,574	45,877	45,877	-	55,574
37	S/DST/SP-274- Dr. Karthick	-	2,10,577	12,198	-	-	1,98,379
38	S/DST/SP-285- Ms Pranitha Pandit	3,28,447	-	8,66,997	8,30,754	3,64,690	-

Amount - Rs.

SR. NO.	PATICULARS	OPENING BALANCE		DURING THE YEAR		CLOSING BALANCE	
		DEBIT	CREDIT	DEBIT	CREDIT	DEBIT	CREDIT
39	S/DST/SP-301- Dr. Ritu Mamgain	-	5,89,817	10,58,414	10,14,715	-	5,46,118
40	S/DST/SP 315- Dr. Garima Mishra	-	-	3,80,247	12,37,921	-	8,57,674
41	S/ DST WOS-B/SP 152	3,19,195	-	-	-	3,19,195	-
42	S/DY Patil Dental College/SP 324- Dr. J.M. Rajwade	-	-	-	1,50,000	-	1,50,000
43	S/DYPatil/SP 273 New D.Y. Patil	-	12,877	-	-	-	12,877
44	S/GCP/SP 166	33,379	-	-	-	33,379	-
45	S/GCP Workshop	-	2,26,032	-	-	-	2,26,032
46	S/HTBSIL/SP 243	-	2,47,542	-	-	-	2,47,542
47	S/HTBS/SP 321- Dr. P.K. Dhakephalkar	-	-	-	3,50,000	-	3,50,000
48	S/ICAR-NASF/SP 319- Dr. R.M. Patil	-	-	3,15,362	4,86,151	-	1,70,789
49	S/ICAR/Soybean Workshop	-	15,634	-	-	-	15,634
50	S/ICAR/ SOY Contract SCH	-	5,872	-	-	-	5,872
51	S/ICAR/SP 001	-	38,59,275	26,08,008	19,37,643	-	31,88,910
52	S/ICAR/SP 002	-	10,58,464	35,06,731	32,72,703	-	8,24,436
53	S/ICAR/SP 003	-	14,77,505	78,39,056	68,45,200	-	4,83,649
54	S/ICAR/SP 033	-	84,39,100	20,46,900	12,28,960	-	76,21,160
55	S/ICAR/SP 034	-	1,030	-	-	-	1,030
56	S/ICAR/SP 043	-	62,650	14,040	1,500	-	50,110
57	S/ICAR/SP 096	-	65,71,568	17,95,971	12,92,667	-	60,68,264
58	S/ICAR/SP 183	-	8,457	-	-	-	8,457
59	S/ICAR/SP 211	-	4,24,762	-	-	-	4,24,762
60	S/ICAR/SP 296- Dr. Philips Varghese	-	5,58,000	-	-	-	5,58,000
61	S/ICAR/Wheat Trial	-	125	-	-	-	125
62	S/ICMR/SP 299- Dr. Dhananjay Bodas	-	23,51,885	26,99,029	12,74,911	-	9,27,767
63	S/IndiaAlliance DBT Wellcome/SP 302- Dr. Patra	-	1,14,54,908	33,14,803	49,76,435	-	1,31,16,540
64	S/Indo Swiss Biotechnology	10,014	-	-	-	10,014	-
65	S/INDO-US Bioremediation	818	-	-	-	818	-
66	S/ISRO/SP 258	21,511	-	-	-	21,511	-
67	S/KPIT/SP 289- Dr. P.K. Dhakephalkar	-	6,71,703	7,55,492	3,61,770	-	2,77,981
68	S/LSRB/SP 145	-	1,204	-	-	-	1,204
69	S/MAX PLANCK/SP 239	-	9,68,129	9,16,320	18,666	-	70,475
70	S/MOEF/SP 279- Dr. Karthick	-	94,026	1,71,871	856	76,989	-
71	S/MoES/SP 266	6,64,320	-	7,66,494	16,55,790	-	2,24,976
72	S/MoES/SP 298- Dr. Tushar Kaushik	-	5,34,489	10,01,918	3,72,276	95,153	-
73	S/NBPL/SP 312- Dr. S.K. Singh	-	-	87,475	2,54,238	-	1,66,763
74	S/OECT/SP 241	1,93,785	-	-	1,93,785	-	-
75	S/OECT/SP 246	1,25,521	-	2,01,620	3,27,141	-	-
76	S/OECT/SP 277- Dr. Dhakephalkar	-	1,21,266	11,67,250	10,45,984	-	-
77	S/OECT/SP 313- Dr. P.K. Dhakephalkar	-	-	6,42,967	21,57,449	-	15,14,482
78	S/ONGC/SP 205	4,53,731	-	-	4,53,731	-	-
79	S/ONGC/SP 235	1,40,277	-	-	1,40,277	-	-
80	S/ONGC/SP 236	-	2,08,447	2,08,447	-	-	-

Amount - Rs.

SR. NO.	PATICULARS	OPENING BALANCE		DURING THE YEAR		CLOSING BALANCE	
		DEBIT	CREDIT	DEBIT	CREDIT	DEBIT	CREDIT
81	S/Pitambari Products Pvt Ltd/SP 269	-	12,475	-	-	-	12,475
82	S/RGSTC/SP 168- Dr. Upadhye	-	19,442	-	-	-	19,442
83	S/RGSTC/SP 231- Dr. Upadhye	-	2,51,958	2,51,958	-	-	-
84	S/RGSTC/SP 283- Dr. Bharati Sharma	-	6,31,668	6,53,761	6,74,160	-	6,52,067
85	S/RGSTC/SP 314 - Dr. P.P. Kulkarni	-	-	7,55,268	18,62,256	-	11,06,988
86	S/SERB/SP 220- Dr. Gargee Pandit	-	31,957	-	-	-	31,957
87	S/SERB/SP 251- Dr. A. Ratnaparkhi	-	1,66,680	-	-	-	1,66,680
88	S/SERB/SP 252- Dr. Karthick Balsubramanian	-	12,616	-	-	-	12,616
89	S/SERB/SP 253- Dr. Rajesh Kumar K C	-	51,755	-	-	-	51,755
90	S/SERB/SP 254- Dr. Vikram Lanjekar	-	41,155	-	-	-	41,155
91	S/SERB/SP 257- Dr. Bodas	-	3,99,873	44,753	-	-	3,55,120
92	S/SERB/SP 259- Dr. Chinmoy Patra	-	3,262	-	-	-	3,262
93	S/SERB/SP 260- Dr. Shravage	-	6,601	51,480	44,879	-	-
94	S/SERB/SP 262- Dr. R. K. Choudhary	-	67,590	67,590	-	-	-
95	S/SERB/SP 264- Dr. R.M. Patil	-	83,930	3,42,390	3,03,175	-	44,715
96	S/SERB/SP 265- Dr. Mandar Datar	-	2,83,724	6,35,162	4,38,725	-	87,287
97	S/SERB/SP 284- Dr. Surajit Roy	-	33,458	95,150	61,692	-	-
98	S/SERB/SP 286- Dr. Monali Rahalkar	-	2,41,929	6,55,010	10,27,944	-	6,14,863
99	S/SERB/SP 287- Dr. Vandana Ghormade	-	1,18,262	8,20,772	9,80,094	-	2,77,584
100	S/SERB/SP 288- Dr. Prasad Kulkarni	-	2,85,395	12,49,098	12,55,312	-	2,91,609
101	S/SERB/SP 290- Dr. Virendra Gajbhiye	-	59,376	12,06,866	11,84,464	-	36,974
102	S/SERB/SP 291- Dr. Abhishek Baghela	-	1,91,136	11,09,921	10,00,265	-	81,480
103	S/SERB/SP 292- Dr. S.A. Tamhankar	-	11,13,333	16,73,673	6,88,675	-	1,28,335
104	S/SERB/SP 294- Dr. Sujata Tetali	-	7,35,159	13,04,026	12,75,000	-	7,06,133
105	S/SERB/SP 295- Dr. Madhuri Pawar	12,073	-	8,94,362	10,62,927	-	1,56,492
106	S/SERB/SP 304- Dr. Bothiraja & Dr. J.M. Rajwade	-	3,13,552	3,89,074	3,38,011	-	2,62,489
107	S/SERB/SP 305- Dr. Mahesh Borde & Dr. S.K. Singh	-	2,69,440	2,45,087	11,004	-	35,357
108	S/SERB/SP 306- Dr. Himanshu	-	8,22,709	10,54,022	10,83,945	-	8,52,632
109	S/SERB/SP 307- Dr. Kriti Sengupta	-	8,39,857	10,62,913	10,41,814	-	8,18,758
110	S/SERB/SP 309- Dr. Anuradha Ratnaparkhi	-	18,07,949	10,81,469	72,589	-	7,99,069
111	S/SERB/SP 311- Dr. Gajbhiye & Dr. Karpe	-	-	13,67,039	22,48,329	-	8,81,290
112	S/SERB/SP 316- Dr. Rajesh Kumar K.C.	-	-	1,48,048	10,16,407	-	8,68,359
113	S/SERB/SP 317- Dr. R.K. Choudhary	-	-	1,47,478	10,78,588	-	9,31,110
114	S/SERB/SP 318- Dr. B.V. Shravage	-	-	4,50,384	29,66,795	-	25,16,411
115	S/SERB/SP 320- Dr. Yogesh Karpe	-	-	1,57,784	13,10,448	-	11,52,664
116	S/SERB/SP 322- Dr. Jyotsna Asthana	-	-	2,76,000	11,38,985	-	8,62,985
117	S/SP 171-B	-	72,149	-	-	-	72,149
118	S/Tata/SP 268- Dr. M. N. Datar	-	5,10,702	99,492	680	-	4,11,890
119	Vishwadeep Pressparts Pvt Ltd	-	3,52,185	-	-	-	3,52,185

Amount - Rs.

SR. NO.	PATICULARS	OPENING BALANCE		DURING THE YEAR		CLOSING BALANCE	
		DEBIT	CREDIT	DEBIT	CREDIT	DEBIT	CREDIT
120	CSIR All Schemes	-	78,608	-	-	-	78,608
121	F/CSIR/Ajay Lagashetti	-	10,000	9,997	-	-	3
122	F/CSIR/Anagha Basargekar	-	20,000	16,602	-	-	3,398
123	F/CSIR/Bhagyashri Joshi	-	11,694	11,694	-	-	-
124	F/CSIR/CONSOLIDATED	-	2,72,122	-	-	-	2,72,122
125	F/CSIR/Darshetkar Ashwini	-	20,000	19,110	-	-	890
126	F/CSIR/Deshpande Payal	-	20,000	-	-	-	20,000
127	F/CSIR/Dr. Ghaskadbi Csir	-	42,541	1,03,118	72,591	-	12,014
128	F/CSIR/Gaikwad Ramesh	-	20,000	-	-	-	20,000
129	F/CSIR/Gulshan Walke	-	403	-	-	-	403
130	F/CSIR/Kumal Kaatri	-	10,585	7,306	-	-	3,279
131	F/CSIR/Kunal Pingale	-	16,721	16,721	-	-	-
132	F/CSIR/Neelam Kapse	-	20,000	7,983	-	-	12,017
133	F/CSIR/Nidhi Murmu	-	20,000	19,999	-	-	1
134	F/CSIR/Nikita Mehta	-	10,000	10,000	-	-	-
135	F/CSIR/Patil Gokul	-	16,721	15,757	-	-	964
136	F/CSIR/Pooja Salunke	-	14,372	11,908	-	-	2,464
137	F/CSIR/Prajakta Tambe	-	6,667	-	-	-	6,667
138	F/CSIR/Pravinkumar Methe	-	19,727	17,605	-	-	2,122
139	F/CSIR/Rameshwar Avchar	-	6,667	6,296	-	-	371
140	F/CSIR/Saurabh Gaikwad	-	18,361	-	-	-	18,361
141	F/CSIR/Smrithy Vijayan	-	16,667	2,000	-	-	14,667
142	F/CSIR/Snehal Jamalpure	-	16,721	13,660	-	-	3,061
143	F/CSIR/Soham Pore	-	1,438	-	-	-	1,438
144	F/CSIR/Sweta Malik	-	10	-	-	-	10
145	F/CSIR/Wadmare Neha	-	20,000	7,980	-	-	12,020
146	F/CSIR/Wagh Ganesh	-	19,071	-	-	-	19,071
147	F/DBT/DBT JRF Vikhe Parimal	-	7,942	5,78,497	3,30,307	2,40,248	-
148	F/DBT JRF/Ameya Rayrikar	-	32,615	2,65,928	1,08,480	1,24,833	-
149	F/DBT JRF/ Pramod Kumar	1,12,493	-	36,400	36,400	1,12,493	-
150	F/DBT/JRF- Sachin Mapari	-	-	67,270	-	67,270	-
151	F/DBT/RA- Dr. Gouri Katre	-	37,374	4,51,634	4,14,260	-	-
152	F/DST INSPIRE/aishwarya Padhye - JRF	-	2,37,888	4,68,528	4,81,280	-	2,50,640
153	F/DST INSPIRE/ Mayuri Shah	-	2,50,400	-	-	-	2,50,400
154	F/DST INSPIRE/ Pankuri K	23,558	-	-	-	23,558	-
155	F/DST INSPIRE/Shradhha Rahi	-	10,174	5,41,235	5,82,666	-	51,605
156	F/DST INSPIRE/Sonali Mundhe	-	3,37,275	5,72,119	5,81,472	-	3,46,628
157	F/ICMR/ Gumaste U	42,498	-	-	-	42,498	-
158	F/ICMR/ Neha Kulkarni	-	5,562	5,43,766	5,40,800	-	2,596
159	F/ICMR/Niraj Ghatpande	-	4,236	4,236	-	-	-
160	F/ICMR/ Nishikant Dixit	81,454	-	8,333	-	89,787	-
161	F/ICMR/ Prabir Kumar	-	5,000	-	-	-	5,000
162	F/SRF/ICMR/Gayatri Kanade	-	1,84,201	2,19,201	35,000	-	-
163	F/SRF/ICMR/Sulaxna Pandey	-	1,93,600	5,59,133	4,95,733	-	1,30,200
164	UGC ALL SCH.	-	5,26,013	-	-	-	5,26,013
	Total	**40,37,585**	**6,73,65,976**	**7,09,54,590**	**7,11,19,027**	**24,02,811**	**6,58,95,640**
			6,33,28,391				**6,34,92,829**

M.A.C.S'S AGHARKAR RESEARCH INSTITUTE, PUNE - 411 004

Schedules Forming Part of Balance Sheet as at 31.03.2021

Schedule 4: Secured Loans and Borrowings

Amount - Rs.

Particulars	Current Year		Previous Year	
1. Central Government		0.00		0.00
2. State Government (Specify)		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
6. Debentures and Bonds		0.00		0.00
7. Others (Specify)		0.00		0.00
TOTAL Rs.		**0.00**		**0.00**

Note: Amounts due within one year Nil

Schedule 5: Unsecured Loans and Borrowings

Amount - Rs.

Particulars	Current Year		Previous Year	
1 Central Government		0.00		0.00
2 State Government (Specify)		0.00		0.00
3 Financial Institutions		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 Intitutions 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 Rs.		**0.00**		**0.00**

Schedule 6: Deferred Credit Liabilities

Amount - Rs.

Particulars	Current Year		Previous Year	
a) Acceptance secured by hypothication 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 Rs.		**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 31.03.2021

Schedule 7: Current Liabilities & Provisions

Amount - Rs.

Particulars	Current Year		Previous Year	
A. Current Liabilities :-				
1. Acceptances	-		-	
2. Sundry Creditors:				
a) For Goods		2,97,999		4,93,810
3. Advances Received	-		-	
4. Interest Accrued but not due on:	-		-	
a) Secured Loans/borrowings	-		-	
b) Unsecured Loans/borrowings	-		-	
5. Statutory Liabilities:	-		-	
a) TDS Payable	11,24,322		10,36,469	
b) Service Tax Output Payable	-		-	
c) PF Commissioner A/c	3,14,481		3,12,181	
d) P.F. New Pension Scheme	88,991		88,991	
e) State Profession Tax	24,100	15,51,894	25,200	14,62,841
6. Other current Liabilities	1,87,78,040	1,87,78,040	75,34,386	75,34,386
7. Unspent Balance of Grant	2,29,02,026		40,12,916	
8. Earnest Money Deposit	7,07,297		10,51,087	
9. Security deposit	5,79,054		7,53,794	
10. Other Tution Fees & University Share	1,12,309		4,10,828	
11. Recovery of Bank Loan	1,500		3,700	
12. Workshops Meetings etc.	20,07,856		18,13,534	
13.Interest Earned Payable to DST	-		-	
14. Retention Money	1,52,967	2,64,63,009	1,52,967	81,98,826
Total (A)		**4,70,90,943**		**1,76,89,863**
B. PROVISIONS				
1. For Taxation	-			
2. Gratuity	9,71,07,380		8,88,04,180	
3. Superannuation/Pension	-		-	
4. Accumulated Leave Encashment	7,47,29,118		6,02,46,494	
5. Trade Warranties/Claims	-		-	
6. Others	-		-	
- Salary payable for March	83,27,797		40,51,031	
- Audit fees	12,000		12,000	
- Electricity & Power	7,06,104		6,69,724	
- Postage & Telephone	35,659		50,843	
- Campus maintainance	4,670		2,27,390	
- Security Service Charges	-		5,34,966	
- Hired Labour Charges	-		3,75,786	
Total (B)		18,09,22,728		15,49,72,414
Total (A+B)		**22,80,13,671**		**17,26,62,277**

MAHARASHTRA ASSOCIATION FOR THE CULTIVATION OF SCIENCE: PUNE - 411 004

Schedules Forming Part of Balance Sheet as at 31.03.2021

Schedule 8 : Fixed Assets

Amount - Rs.

	DESCRIPTION	GROSS BLOCK						DEPRECIATION					NET BLOCK	
		Cost/ valuation As at beginning of the year	Rate of Dep.	Deletions during the year	Net cost as on 31.3.2021	Additions during the year	Cost valuation at the year-end	As at the beginning of the year	Dep. on the opening cost	Dep. On Additions during the year	Total dep. during 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- Land at Hol	1,70,514	-	-	1,70,514	-	1,70,514	-	-	-	-	-	1,70,514	1,70,514
	Land at Hol (Donated by G.O.M)	4,400	-	-	4,400	-	4,400	-	-	-	-	-	4,400	4,400
	b> Leasehold													
2	**BUILDINGS**			-	-	-	-	-	-	-	-	-	-	-
	a> On Freehold	8,08,65,397	-	-	8,08,65,397	16,54,866	8,25,20,263	2,62,56,164	20,21,635	20,686	20,42,321	2,82,98,485	5,42,21,778	5,46,09,232
	b> On Leasehold	-		-	-	-	-	-	-	-	-	-	-	-
	c> Ownership Flats/Premises	-		-	-	-	-	-	-	-	-	-	-	-
	d> Superstructures on Land and not belonging to the entity	-	-	-	-	-	-	-	-	-	-	-	-	-
	e> Temporary Structures	23,33,896	2.5%	-	23,33,896	-	23,33,896	9,07,125	58,332	-	58,332	9,65,456	13,68,440	14,26,771
3	**PLANT MACHINERY & EQUIPMENT**	31,60,83,993	10% / 20%	9,000	31,60,74,993	1,65,27,366	33,26,02,359	22,67,91,132	26,62,799	18,12,600	44,75,399	23,12,66,531	10,13,35,828	8,92,92,861
4	**VEHICLES**	32,28,380	20%	-	32,28,380	-	32,28,380	23,67,138	1,55,905	-	1,55,905	25,23,043	7,05,337	8,61,242
5	**FURNITURE,FIXTURES**	3,41,05,160	10%		3,41,05,160	1,25,14,316	4,66,19,476	2,00,74,540	8,62,887	6,26,833	14,89,721	2,15,64,261	2,50,55,215	1,40,30,620
6	**COMPUTER/PERIPHERALS**	2,05,02,283	20%	-	2,05,02,283	8,69,725	2,13,72,008	1,89,93,139	75,809	86,973	1,62,782	1,91,55,921	22,16,087	15,09,144
7	**COMPUTER SOFTWARE**	41,23,180	60%	-	41,23,180	9,67,166	50,90,346	30,24,559	4,38,157	3,67,181	8,05,338	38,29,897	12,60,449	10,98,621
8	**ELECTRIC INSTALLATIONS**	2,01,53,374	10% / 15%	-	2,01,53,374	6,16,044	2,07,69,418	1,08,07,955	16,09,842	30,802	16,40,644	1,24,48,599	83,20,819	93,45,419
9	**LIBRARY BOOKS**	1,10,15,876	20%	195	1,10,15,681	8,10,476	1,18,26,157	91,87,846	1,59,291	81,028	2,40,319	94,28,165	23,97,992	18,28,030
10	**OTHER FIXED ASSETS**	1,01,75,046	-	-	1,01,75,046	-	1,01,75,046	31,75,792	2,54,376	-	2,54,376	34,30,168	67,44,878	69,99,254
	TOTAL OF CURRENT YEAR	**50,27,61,499**		**9,195**	**-**	**3,39,59,959**	**53,67,12,263**	**32,15,85,390**	**82,99,034**	**30,26,103**	**1,13,25,137**	**33,29,10,526**	**20,38,01,737**	**18,11,76,109**
	PREVIOUS YEAR	49,22,61,704		23,750	-	52,01,303	50,27,64,199	31,26,81,859	82,76,055	6,27,474	89,03,530	32,15,85,390	18,11,76,109	18,49,07,987
	TOTAL (A)	**50,27,61,499**		**9,195**	**-**	**3,39,59,959**	**53,67,12,263**	**32,15,85,390**	**82,99,034**	**30,26,103**	**1,13,25,137**	**33,29,10,526**	**20,38,01,737**	**18,11,76,109**
B	**CAPITAL W.I.P**													-
	CENTRAL PUBLIC WORKS DEPT	1,67,12,779		-	-	-	-	-	-	-	-	-	20,57,913	1,67,12,779
	TOTAL (A+B)												**20,58,59,651**	**19,78,88,888**

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 31.03.2021

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

Amount - Rs.

Particulars	Current Year	Previous Year
1. In Government Securities	-	-
2. Other approved Securities	-	-
3. Shares	-	-
4. F.D.R. with Indian Bank (Dr. A.B. Joshi Donation)	2,50,000	2,50,000
5. Subsidiaries and Joint Ventures	-	-
6. Others (Fixed Deposits) (Dr. A.D. Agate Donation)	5,001	5,001
7. Others Fixed Deposits from Lab. Reserve Fund (Tech. Dev. Fund A/c:SBI)	9,29,11,234	8,79,31,781
8. Others (Fixed Deposits UBI)	1,03,26,125	1,26,62,157
TOTAL (Rs.)	**10,34,92,360**	**10,08,48,939**

Schedule 10: Investments - Others

Amount - Rs.

Particulars	Current Year	Previous Year
In Government Securities	0.00	0.00
Other approved Securities	0.00	0.00
Shares	0.00	0.00
Debentures and Bonds	0.00	0.00
Subsidiaries and Joint Ventures	0.00	0.00
TOTAL Rs.	0.00	0.00

Schedule 11: Current Assets, Loans & Advances

Amount - Rs.

Particulars	Current Year		Previous Year	
A. CURRENT ASSETS:				
1. Inventories:				
a> Stores and Spares				
b> Publications	20,525		20,525	
c> Stock-in-trade of consumables (as taken valued and certified by the Management)	2,23,839	2,44,364	2,47,518	2,68,043
2. Sundry Debtors:				
a> Debts Outstanding for a period exceeding six months				
3. Cash balances in hand(including cheques/drafts and imprest)	31,378	31,378	49,805	49,805

Amount - Rs.

Particulars	Current Year		Previous Year	
4. Bank Balances:				
a> With scheduled Banks				
-On Current Accounts	2,26,57,119		1,55,84,740	
-On Deposit Accounts	-		-	
-On Savings Accounts	6,40,56,806		3,15,76,471	
- On Current Accounts(TDF)	2,50,63,811	11,17,77,737	1,23,09,097	5,94,70,308
b> With non-Scheduled Banks:				
-On Current Accounts	-		-	
-On Deposit Accounts	-		-	
-On Savings Accounts	-		-	
TOTAL (A)		**11,20,53,479**		**5,97,88,156**
B. LOANS, ADVANCES AND OTHER ASSETS				
1. Loans:				
a> Staff (For HBA, Vehicle Advance and Computer)	3,600		10,800	
d) Amount receivable from Schemes	23,91,995	23,95,595	27,67,005	27,77,805
2. Advances and other amounts recoverable in cash or in kind or for value to be received:				
a> On Capital & Revenue Expenditure	-		-	
b> Prepayments(Cash Insurance)	-		-	
c> Advances to staff (For TA etc.)	68,920		2,57,898	
e> Festival Advance	-		-	
f> Deposits kept with Govt. Agencies (MSEB, Telephone, Gas Cylinder etc.)	10,99,413	11,68,333	11,09,413	13,67,311
3.Income Accrued:				
a> On Investments from Earmarked/ Endowment Funds	22,27,237		17,02,457	
b> On Loans and Advances(HBA, Vehicle Adv. & Computer Adv.)	6,400		9,625	
4. Sundry Debtors	5,76,438		62,340	
5. Advance to Suppliers (Prior to 2013-14)	6,87,528		6,87,528	
6. Income Tax (TDS)	23,39,459		16,04,342	
7. Income Tax (TDS) (Prior to 2010)	6,21,213		6,21,213	
8. GST Input /Service Tax Input	32,03,563		28,28,175	
9. Kumar Krishi Mitra Fellowship	31,281	96,93,120	31,281	75,46,961
Total (B)		**1,32,57,048**		**1,16,92,077**
C. NET CURRENT ASSETS AGAINST SPONSORED SCHEMES		6,34,92,829		6,33,28,391
TOTAL (A+B+C)		**18,88,03,355**		**13,48,08,624**

M.A.C.S'S AGHARKAR RESEARCH INSTITUTE, PUNE - 411 004

Schedules forming part of Income & Expenditure Account for the year ended 31.03.2021

Schedule 12: Income From Sales/Services

Amount - Rs.

Particulars	Current Year	Previous Year
1. Income from Sales		
a) Sales of Finished Goods (Farm Produce)	-	9,65,161
b) Sale of Raw Material	-	6,300
c) Sale of Scraps	-	-
2. Income from Services		
b) Cultural Identification Charges/ Analytical Services	16,10,640	14,76,119
d) Others	89,698	1,54,371
e) Testing fees-Soyabean/Wheat	-	-
f) Course Fees- Summer 2019	-	3,85,500
Total (Rs.)	**17,00,338**	**29,87,451**

Schedule 13: Grants/Subsidies

Amount - Rs.

Particulars	Current Year	Previous Year
1. Central Government	27,00,00,000	18,90,51,000
Add: Unspent balance at the beginning of the year	40,12,916	2,03,91,856
Add: Interest Earned on Grant	14,47,869	6,34,746
Less: Unspent balance at the year end	2,29,02,026	40,12,916
Less: Interest refund back to DST	7,31,864	14,85,308
	25,18,26,895	**20,45,79,378**
2. State Government	-	-
3. Government Agencies	-	-
4. Institutions/Welfare Bodies	-	-
5. International Organisations		
6. Others (Specify)	-	-
Net Surplus of sale of Assets	-	-
Total (Rs.)	**25,18,26,895**	**20,45,79,378**

* Unspent balance of grant is against recurring balance & non-recurring balance is regrouped under Schedule I Capital Fund

Schedule 14: Fees/Subscriptions

Amount - Rs.

Particulars	Current Year	Previous Year
1. Entrance Fees (Library Membership fees)	24,000	1,00,000
2. Annual Fees (Licence fees)/Subscriptions	21,920	22,369
3. Seminar/Program Fees	-	-
4. Others (Ph.D. Tuition fee, Ph.D. Provisional Admission fee)	2,16,000	6,89,200
Total (Rs.)	**2,61,920**	**8,11,569**

M.A.C.S'S AGHARKAR RESEARCH INSTITUTE, PUNE - 411 004

Schedules forming part of Income & Expenditure Account for the year ended 31.03.2021

Schedule 15: Income From Investments

Amount - Rs.

INCOME FROM INVESTMENTS: (Income on Invest. From Earmarked/ Endowment Funds transferred to Funds.)	INVESTMENT FROM EARMARKED FUND		INVESTMENT - OTHERS	
	Current Year	Previous Year	Current Year	Previous
1. Interest				
a> On Govt. Securities	0.00	0.00	0.00	0.00
b> Other Bonds/Debentures	0.00	0.00	0.00	0.00
2. Dividends				
a> On Shares	0.00	0.00	0.00	0.00
b> On Mutual Fund Securities	0.00	0.00	0.00	0.00
3. Rents	0.00	0.00	0.00	0.00
4. Others (Interest on bank deposits)	0.00	0.00	0.00	0.00
Total Rs.	**0.00**	**0.00**	**0.00**	**0.00**
TRANSFERRED TO EARMARKED/ ENDOWMENTFUND	**0.00**	**0.00**	**0.00**	**0.00**

Schedule 16: Income from Royalty, Publications, etc.

Amount - Rs.

Particulars	Current Year	Previous Year
1. Income from Royalty	-	-
2. Income from Publications	-	910
3. Others (Sale of Tender Forms/I Cards)	-	3,500
4. Application Money	-	26,850
Total (Rs.)	**-**	**31,260**

Schedule 17 : Interest Earned

Amount - Rs.

Particulars	Current Year	Previous Year
1. On Term Deposits		
a) With Scheduled Banks	-	-
b) With Non-Scheduled Banks	-	-
2. On Saving Accounts		
a) With Scheduled Banks	11,40,761	23,45,953
b) With Non-Scheduled Banks	-	-
c) Post Office Savings Accounts	-	-
3. On Loans		
a) Employees/Staff (On HBA, Vehicle and Computer Advance)	-	97,118
b) Interest Received on L.C	38,289	-
4. Interest on Debtors and Other Receivables	638	-
Total (Rs.)	**11,79,688**	**24,43,071**

* Interest earned on DST grant & HBA, Vehical & Computer for F.Y 2020-21 added back to grant balance

M.A.C.S'S AGHARKAR RESEARCH INSTITUTE, PUNE - 411 004

Schedules forming part of Income & Expenditure Account for the year ended 31.03.2021

Schedule 18 : Other Income

Amount - Rs.

Particulars	Current Year	Previous Year
1) Profit on Sale/Disposal of Assets:		
a) Owned Assets	-	-
b) Assets acquired out of grants, or received free of cost		
2) Export Incentives realized	-	-
3) Fees for Miscellaneous Services	1,89,134	7,83,396
4) Miscellaneous Income	7,12,898	1,95,858
Total (Rs.)	**9,02,032**	**9,79,254**

Schedule 19: Increase/(Decrease) In The Stock Of Finished Goods & Work In Progress

Amount - Rs.

Particulars	Current Year	Previous Year
a) Closing stock		
- Laboratory Consumables	2,23,839	2,47,518
- Finished Goods	-	-
- Publications	20,525	20,525
	2,44,364	2,68,043
b) Less: Opening Stock		
- Laboratory Consumables	2,47,518	3,23,846
- Finished Goods	-	-
- Publications	20,525	20,525
	2,68,043	3,44,371
Net Increase/(Decrease)	**(23,679)**	**(76,328)**

Schedule 20 : Establishment Expenses

Amount - Rs.

Particulars	Current Year	Previous Year
1) Salaries and Wages	16,11,64,704	13,84,06,883
2) Allowances and Bonus	22,47,191	24,66,512
3) Contribution to Provident Fund & New Pension Scheme	1,36,87,104	1,33,62,835
4) Contribution to Other Fund (D.L.I.F.)	2,75,228	2,95,576
5) Staff Welfare Expenses	13,20,926	12,59,401
6) Expenses on Employees Reitrement and Terminal Benefits	5,41,47,235	1,96,39,856
7) Stipend to Research & Fellowship Students	28,40,060	27,91,510
8) Encashment of Earned Leave for LTC	52,31,716	8,93,019
TOTAL	**24,09,14,164**	**17,91,15,592**

M.A.C.S'S AGHARKAR RESEARCH INSTITUTE, PUNE - 411 004

Schedules forming part of Income & Expenditure Account for the year ended 31.03.2021

Schedule 21: Other Administrative Expenses

Amount - Rs.

Particulars	Current Year	Previous Year
ADVERTISEMENT & PUBLICITY	3,23,703	35,525
AUDITORS REMUNERATION	14,920	47,400
ELECTRICITY & POWER	71,57,523	83,97,089
FARM EXPENSES	9,23,413	33,65,248
HOSPITALITY EXPENSES	35,562	1,83,847
INSURANCE	3,735	3,735
LEGAL & PROFESSIONAL FESS	2,98,000	7,81,774
OTHER OFFICE EXPENSES	2,46,645	4,94,610
POSTAGE, TELEPHONE & COMMUNICATION	5,25,392	7,96,795
PRINTING & STATIONERY	4,09,181	7,88,610
PURCHASES OF CHEMICALS & GLASSWARE	36,83,288	88,95,817
RENT RATES & TAXES	16,23,611	16,38,307
REPAIRS & MAINTENANCE	75,93,985	79,33,303
RETIRED STAFF MEDICAL EXPENSES	13,68,998	4,41,285
SECURITY & LABOUR EXPENSES	1,05,18,121	91,57,175
SEMINAR /WORKSHOP EXPENSES	2,35,281	8,25,275
SUBSCRIPTION FEES	1,76,721	1,77,339
TRAVELLING & CONVEYANCE	23,969	5,45,985
VEHICLE RUNNING AND MAINT EXPS	85,256	1,51,134
WATER CHARGES	12,18,422	11,32,414
Total (Rs.)	**3,64,65,727**	**4,57,92,666**

Schedule 22: Expenditure on Grants, Subsidies etc.

Amount - Rs.

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

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 Rs.		**0.00**		**0.00**

M.A.C.S'S AGHARKAR RESEARCH INSTITUTE, PUNE - 411 004

Schedules forming part of Income & Expenditure Account for the year ended 31.03.2021

Schedule D: Transfer to Capital Fund

Amount - Rs.

Particulars	Current Year		Previous Year	
Other Fixed Assets				
Books	8,10,476		1,28,926	
Buildings	16,54,866		6,72,356	
Computer / Peripherials/Softwares	18,36,891		2,68,068	
Office Furniture & Dead Stock	1,25,14,316		2,04,115	
App. & Equipments	1,65,27,366		39,06,643	
Electrical Installation	6,16,044		-	
Temporary Structures	-		21,195	
		3,39,59,959		**52,01,303**

As per our report of even date
For **DCRK & ASSOCIATES**
Chartered Accountants
FRN:127831W

Sd/-
FINANCE & ACCOUNTS OFFICER
MACS ARI

Sd/-
DIRECTOR
MACS ARI, PUNE

Saideep Dhoble Patil
Partner

Place: Pune
Date: 30/07/2021

FORM OF FINANCIAL STATEMENTS: Non –profit making organization

Name of Entity: M.A.C.S'S AGHARKAR RESEARCH INSTITUTE, PUNE - 411 004

Schedules forming part of the Accounts for the period ended 31.03.2021

Schedule 24: Significant Accounting Policies

a. Accounting Convention

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 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 the 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 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 where required, provision is made for permanent diminution in the value of such investment.
2. Investment classified as "Current" is valued at cost and market value.
3. Cost means acquisition cost which includes acquisition expenses like brokerage, transfer stamp, etc.

g. Revenue Recognition

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

h. Accounting for Government Grants

1. Government grants of the nature of contribution towards capital cost of setting projects as capital reserve

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 the employees are entitled to receive the benefit as each year end which is also done on Actuarial Valuation.

j. Capitalization

1. All direct expenses attributable to fixed asset acquired are capitalized.

As per our report of even date
For **DCRK & ASSOCIATES**
Chartered Accountants
FRN:127831W

Sd/-
FINANCE & ACCOUNTS OFFICER
MACS ARI

Sd/-
DIRECTOR
MACS ARI, PUNE

Saideep Dhoble Patil
Partner

Place: Pune
Date: 30/07/2021

FORM OF FINANCIAL STATEMENTS: Non –profit making organization

Name of Entity: M.A.C.S'S AGHARKAR RESEARCH INSTITUTE, PUNE - 411 004

Schedules forming part of the Accounts for the period ended 31.03.2021

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)
- Letter of credit. opened by bank behalf of the entity -Nil (Previous Year- Nil)
- 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. Current Assets, 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.

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 India (ICAI).

6. Grants

Grants are recognized on receipts. Grants received from Department of Science & Technology (DST) for Creation of Capital Assets are treated as Capital Fund of the Institute. Grants received for General, Salaries and Salaries-SC are treated as of revenue nature and shown under Income & Expenditure Account.

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.	Particular	For year ended 31st March 2021
1	Withdrawal Rate	2.00%
2	Discounting Rate	6.80%
3	Future Salary Rise	5.00%

The position of gratuity payable on death/retirement of employees and leave encashment as on 31st March, 2021 is as below

Particulars	Provision for Gratuity	Provision for Leave Encashment
Opening balance as on 1st April 2020	8,88,04,180	6,02,46,494
Add:- Addition during the year 2020-21	83,03,200	1,44,82,624
Less:- Deduction during the year 2020-21	.....	.....
Closing Balance as on 31st March 2021	9,71,07,380	7,47,29,118

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

10. Third party confirmation is necessary for confirming the balances appearing in the books of account and also long outstanding of balances as at the Balance Sheet date hence, we are unable to comment on the accuracy of such third party balances.

11. Provisions are recognized 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.

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

13. Depreciation on fixed assets has been provided on straight line basis (SLM) as per the rates prescribed under the Bombay Public Trust Act, 1950.

As per our report of even date
For **DCRK & ASSOCIATES**
Chartered Accountants
FRN:127831W

Sd/-
FINANCE & ACCOUNTS OFFICER
MACS ARI

Sd/-
DIRECTOR
MACS ARI, PUNE

Saideep Dhoble Patil
Partner

Place: Pune
Date: 30/07/2021

Covid-19 Volunteers

Covid-19 Testing

Maharashtra Association for the Cultivation of Science
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