



**Hands on  
Training  
Program**

**ADVANCES IN  
FUNCTIONAL  
GENOMICS & GENE  
EDITING**

**PROCEEDINGS**

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**November 14<sup>th</sup>-19<sup>th</sup>, 2022**

**ORGANIZED BY**

**DEPARTMENT OF BIOTECHNOLOGY**

**PANJAB UNIVERSITY (PU), CHANDIGARH**

**IN ASSOCIATION WITH**

**SOPHISTICATED ANALYTICAL INSTRUMENTATION FACILITY (SAIF)**

**PANJAB UNIVERSITY (PU), CHANDIGARH**



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सत्यमेव जयते  
Department of Science & Technology  
Govt. of India

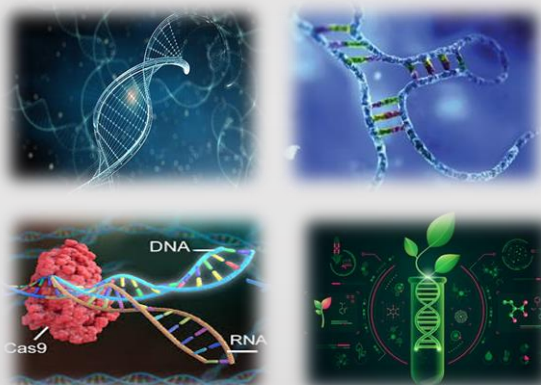
## Hands on Training Program

# ADVANCES IN FUNCTIONAL GENOMICS & GENE EDITING

UNDER

Synergistic Training Program Utilizing the Scientific and Technological Infrastructure (STUTI)

Date: 14<sup>th</sup>–20<sup>th</sup> November 2022



ORGANIZED BY

DEPARTMENT OF BIOTECHNOLOGY  
PANJAB UNIVERSITY, CHANDIGARH

IN ASSOCIATION WITH

SOPHISTICATED ANALYTICAL INSTRUMENTATION FACILITY (SAIF)  
PANJAB UNIVERSITY, CHANDIGARH

PROF. KASHMIR SINGH  
Convenor  
Department of Biotechnology  
PANJAB UNIVERSITY, CHANDIGARH

PROF. G. R. CHAUDHARY  
Coordinator  
STUTI Program-PMU  
PANJAB UNIVERSITY, CHANDIGARH

Dr. SANTOSH KUMAR UPADHYAY  
Co-convenor  
Department of Biotechnology  
PANJAB UNIVERSITY, CHANDIGARH

## Message



A congratulations to the all the participants of the Training Program entitled “Advances in Functional Genomics & Gene Editing” under the “Synergistic Training program Utilizing the Science and Technological Infrastructure (STUTI)” organized at the Department of Biotechnology, PU, Chandigarh. I also extend my sincere thanks and congratulations to the Department of Science and Technology (DST) for awarding the grant under the STUTI program.

I congratulate Sophisticated Analytical Instrumentation Facility (SAIF)/ Central Instrumentation Laboratory (CIL), Panjab University, Chandigarh for being selected as a Program Management Unit (PMU) and also for executing their role as a hub manager for working in an ensemble with many other educational and research institutes/universities to fulfil the aims of this program.

I applauded the efforts of the organizing team of the STUTI Training Program, GNDU, Amritsar for successfully completing the Training Program that helps the young researchers to learn the analytical & Instrumentation techniques.

Prof. Raj Kumar  
Vice-Chancellor  
Panjab University  
Chandigarh

## Message



It is my privilege to congratulate you all for the successful completion of 7-day training programme on “Advances in Functional Genomics & Gene Editing” organized by Department of Biotechnology, Panjab University, Chandigarh under the aegis of STUTI in collaboration with SAIF/CIL, Panjab University.

The Training program encompassed computational methods of utilizing big data for the prediction of non-coding and coding genes and their characterization, and functional validation of genes using overexpression and gene editing tools such as CRISPR/Cas systems. This field overlaps with other areas of biology, material science, pharmaceutical sciences and many more. This workshop would help the emerging students and researchers in multidisciplinary fields to gain a better understanding of methods in biology.

I feel delighted that this training program have provided practical hands-on training to faculty, post-doc fellows, PhD Fellows in multidisciplinary fields to attain basic and advanced level training in genomics and gene editing techniques to get insight into their research. I extend my sincere thanks and appreciation to all for their cooperation, support and hard work.

Prof. Kashmir Singh  
Convenor  
Department of Biotechnology  
Panjab University  
Chandigarh

## Message



I feel delighted to share that the STUTI Program has been a great success so far. The prestigious DST-supported STUTI program envisions hands-on Training Programs and sensitization of the state-of-the-art equipment as well as toward its sharing in various institutions while ensuring the transparent access to science & technology facilities.

Sophisticated Analytical Instrumentation Facility (SAIF), Panjab University, Chandigarh express our deepest gratitude to the Department of Science and Technology for choosing us to act as a Program Management Unit (PMU) and feel proud to be a part of this program.

The Training program on “Advances in Function Genomics & Gene Editing” at the Department of Biotechnology, Panjab University, Chandigarh provided practical hands-on training on computational methods of utilizing big data for the prediction of non-coding and coding genes and their characterization, and functional validation of genes using overexpression and gene editing tools such as CRISPR/Cas systems.

Prof. G. R. Chaudhary  
STUTI Coordinator-PMU  
Panjab University  
Chandigarh

## Message



I congratulate you all for the successful organization and completion of the training program on “Advances in Functional Genomics & Gene Editing” at the Department of Botany, Panjab University, Chandigarh under the aegis of STUTI in collaboration with SAIF/CIL, Panjab University.

The Training program revolved around the data analysis, characterization and prediction of non-coding and coding genes, and their validation using overexpression and gene editing tools like CRISPR/Cas systems. The training program also provided a platform for faculty, post-doc fellows, and PhD fellows to vast their expertise in genomics and gene editing techniques, ultimately benefiting their research.

We hope that this training program stimulated new ideas and approaches for promoting research and technical skills. Thank you for your participation and we wish you a good luck in the Future.

Dr. Santosh Upadhyay  
Assistant Professor  
Department of Botany  
Panjab University  
Chandigarh

## PROGRAM SCHEDULE

**Venue: Seminar Hall, Department of Biotechnology, Panjab University, Chandigarh**

<b>Day 1 (14<sup>th</sup> Nov, 2022)</b>		<b>Venue: (Seminar Hall, 1<sup>st</sup> Floor)</b>
<b>Session-I: Inaugural</b>		
9:30 AM - 10:00 AM	Inaugural ceremony	
	Welcome Address Dr. Kashmir Singh, Professor, Department of Biotechnology, Panjab University.	
10:00 AM - 11:30 AM	Inaugural Lecture	
	Address By Chief Guest Prof. Raj Kumar, Hon'ble Vice-Chancellor, Panjab University, Chandigarh.	
	Vote of thanks and High tea Group Photograph	
11:15 AM - 12:15 PM	<b>Expert Lecture 1 By Prof. Zofia Szweykowska-Kulińska</b> "Functions of barley microRNAs from MIR 444 family and the role of their targets".	
1:00 PM - 2:00 PM	Lunch	
<b>Session-II: Lecture</b>		<b>Venue: (Seminar Hall, 1<sup>st</sup> Floor)</b>
2:15 PM - 3:30 PM	<b>Expert Lecture 2 By Prof. Artur Jarmołowski</b> "R-loops at microRNA encoding loci promote co-transcriptional processing of pri-miRNAs in plants".	
3:30 PM - 3:50 PM	Tea	
3:50 PM - 5:00 PM		
<b>Day 2 (15<sup>th</sup> Nov, 2022)</b>		<b>Venue: (Seminar Hall, 1<sup>st</sup> Floor)</b>
<b>Session-III: Lectures &amp; Hands-On Session</b>		
9:15 AM - 10:15 AM	<b>Expert Lecture 3 By Dr. Halina Pietrykowska</b> "The impact of MpDUSP12- miRNA8185 module on Marchantia polymorpha sexual reproductive success".	
10:30 AM - 11:00 AM	<b>Hands-On Session-I</b> Genome-wide identification and characterization of gene family	
11:00 AM - 11:15 AM	Tea	
11:15 AM - 1:00 PM	<b>Hands-On Session-I (contd.)</b>	
1:00 PM - 2:00 PM	Lunch	
<b>Session-IV: Lectures &amp; Hands-On Session</b>		<b>Venue: (Seminar Hall, 1<sup>st</sup> Floor)</b>
2:15 PM - 3:15 PM	<b>Expert Lecture 4 By Dr. Kumardeep Chaudhary</b> "Promise of AI for Novel Discoveries in the Era of Big Data". The participants are free to have an in-depth discussion.	
3:15 PM - 5:00 PM	<b>Hands-On Session-II</b> Global identification of miRNA (novel & conserved) and their characterization	
<b>Day 3 (16<sup>th</sup> Nov, 2022)</b>		<b>Venue: (NABI)</b>
<b>Session-V: Lectures</b>		
9:15 AM - 10:15 AM	<b>Expert Lecture 5 By Dr. Siddharth Tiwari</b> "Applications and regulations of genome editing in traits improvement in plants." The participants are free to have an in-depth discussion.	
1:00 PM - 2:00 PM	Lunch	
<b>Session-VI: Lectures</b>		<b>Venue: (CIAB)</b>
2:15 PM - 3:15 PM	<b>Expert Lecture 6 By Dr. Sudhir P. Singh</b> "Metagenomic investigations for discovery and characterization of novel genes for biocatalytic production of functional sugars of rare occurrence." The participants are free to have an in-depth discussion.	
<b>Day 5 (17<sup>th</sup> Nov, 2022)</b>		<b>Venue: (Seminar Hall, 1<sup>st</sup> Floor) (Lab, Ground Floor)</b>
<b>Session-VII: Lectures &amp; Hands-On Session</b>		
9:15 AM - 10:15 AM	<b>Expert Lecture 7 By Dr. Rupesh Deshmukh</b> The participants are free to have an in-depth discussion.	
10:15 AM - 11:00 AM	<b>Hands-On Session-V</b>	

11:00 AM- 11:15 AM	Tea
11:15 AM – 1:00 PM	<b>Hands-On Session-V (contd.)</b>
1:00 PM - 2:00 PM	Lunch
<b>Session-VIII: Lectures &amp; Hands-On Session</b> <b>Venue: (Seminar Hall, 1<sup>st</sup> Floor) (Lab, Ground Floor)</b>	
2:15 PM – 3:15 PM	<b>Expert Lecture 8 By Dr. Nitin Singhal</b> The participants are free to have an in-depth discussion.
3:15 PM – 5:00 PM	<b>Hands-On Session-VI</b>
<b>Day 6 (18<sup>th</sup> Nov, 2022)</b>	
<b>Session-IX: Lectures &amp; Hands-On Session</b> <b>Venue: (Seminar Hall, 1<sup>st</sup> Floor) (Lab, Ground Floor)</b>	
9:15 AM – 10:15 AM	<b>Expert Lecture 9 By Dr. Ashutosh Pandey</b> “Emerging genome editing tools in food crops for enhancing nutritional value and food security”. The participants are free to have an in-depth discussion.
10:15 AM – 11:00 AM	<b>Hands-On Session-VII</b>
11:00 AM- 11:15 AM	Tea
11:15 AM – 1:00 PM	<b>Hands-On Session-VII (contd.)</b>
1:00 PM - 2:00 PM	Lunch
<b>Session-X: Lecture &amp; Hands-On Session</b> <b>Venue: (Seminar Hall, 1<sup>st</sup> Floor) (Lab, Ground Floor)</b>	
2:15 PM – 3:15 PM	<b>Expert Lecture 10 By Dr. Alok Sinha</b> “Regulation of cell cycle by Mitogen Activated Protein Kinase cascade in rice”. The participants are free to have an in-depth discussion.
3:15 PM – 5:00 PM	<b>Hands-On Session-IX</b>
<b>Day 7 (19<sup>th</sup> Nov, 2022)</b>	
<b>Session-XI: Lectures &amp; Hands-On Session</b> <b>Venue: (Seminar Hall, 1<sup>st</sup> Floor) (Lab, Ground Floor)</b>	
9:15 AM - 10:15 AM	<b>Expert Lecture 11 By Dr. Shashi Rhode</b> “Synthetic biology application in photosynthetic organisms for value-added products.” The participants are free to have an in-depth discussion.
10:15 AM – 11:00 AM	<b>Hands-On Session-X</b>
11:00 AM- 11:15 AM	Tea
11:15 AM – 1:00 PM	<b>Hands-On Session-X (contd.)</b>
1:00 PM - 2:00 PM	Lunch
<b>Session-XII: Lectures&amp;Hands-On Session</b> <b>Venue: (Seminar Hall, 1<sup>st</sup> Floor) (Lab, Ground Floor)</b>	
2:15 PM – 3:15 PM	<b>Expert Lecture 12 By Dr. Arun Kumar</b> “Molecular dissection of Rice-R. solani AG1-IA interactions to develop sheath blight resistance in rice.” The participants are free to have an in-depth discussion.
3:15 PM – 5:00 PM	<b>Hands-On Session-XI</b>
<b>Day 8 (20<sup>th</sup> Nov, 2022)</b>	
<b>Session-XI: Lectures &amp; Valedictory Function</b> <b>Venue: (Seminar Hall, 1<sup>st</sup> Floor)</b>	
9:15 AM - 10:15 AM	<b>Expert Lecture 13 By Dr. Ajay Pandey</b> The participants are free to have an in-depth discussion.
10:15 AM – 11:15 AM	<b>Expert Lecture 14 By Dr. Saravjeet Singh Gill</b> The participants are free to have an in-depth discussion.
11:15 AM – 12:00 PM	<b>Valedictory Function</b>
12:00 PM – 1:00 PM	<b>Lunch</b>



## **DAY 1 INAUGURATION**

Panjab University (PU), Chandigarh in collaboration with Sophisticated Analytical Instrumentation Facility (SAIF) at Central Instrumentation Lab (CIL), Panjab University, Chandigarh, hosted a hands-on training session on “Advances in Functional Genomics & Gene Editing” from 14<sup>th</sup> to 19<sup>th</sup> November. The training programme was organized by the Department of Biotechnology, Panjab University, Chandigarh.

The scheme “Synergistic Training Programme Utilizing the Scientific and Technological Infrastructure” (STUTI) is intended to build human resources and their knowledge capacity through open access infrastructure across the country. As a complement to the various schemes of Department of Science and Technology, the funding for the expansion of research and development infrastructure at academic institutions, the STUTI scheme envisions a hands-on training programme and sensitization of the state-of-the-art equipment as well as towards sharing while ensuring transparent access to science and technology facilities.

The training program is commenced with the patronship of Honorable Prof. Raj Kumar, Vice-chancellor, PU and inaugurated by Worthy Guest of Honor, Prof. Dr. Zofia Szweykowska-Kulinska and Prof. Artur Jarmolowski, Department of Gene Expression, Adam Mickiewicz University of Poznan, Poland. Prof. Kashmir Singh, Department of Biotechnology, PU, is the convenor of the STUTI training program. Dr. Santosh Kumar Upadhyay, Department of Botany, PU, is the co-convenor of the STUTI training program. Prof. Ganga Ram Chaudhary is the Coordinator of the STUTI

Chandigarh. A felicitation of the Dignitaries and their address to the participants took place during the event.

Prof. Kashmir Singh highlights the key points of the training program, its schedule and emphasizes on the importance of the training program.

Prof. Kashmir Singh gives cordial welcome to the Chief Guest, Guests of Honour and all the participants of the program. Prof. Ganga Ram Chaudhary emphasized on the goals and visions of the STUTI scheme to the participants.

Participants from various institutes all across the India have participated at the inauguration of the training program. Various speakers from different universities & industries are invited to deliver a talk on advances in functional genomics and gene editing followed by the hands-on training.





## DAY 1

Prof. G.R. Chaudhary emphasized on the importance of the STUTI program, its goal and learning outcomes. He further highlights the instrumentation facilities available along with their applications in the SAIF/CIL centre, Punjab University.



Prof. Dr. Zofia Szweykowska-Kulinska, Department of Gene Expression, Adam Mickiewicz University of Poznan, presented a talk on “Functions of barley microRNAs from MIR 444 family and the role of their targets”. Research work involving functional characterization of miRNAs and their targets under abiotic stresses was presented to the participants. A detailed discussions on doubts and queries were held during the lecture.

## DAY 1



Prof. Artur Jarmołowski, Department of Gene Expression, AMU, Poland, is also an active EMBO member. During the second session, he delivered a talk on the role of R-loops of miRNA in the processing of pri-miRNA in plants. The process of miRNA biogenesis involving co-transcriptional and post-transcriptional processing of pri-miRNA was described to the participants in detail. An interactive session took place between the



## DAY 2

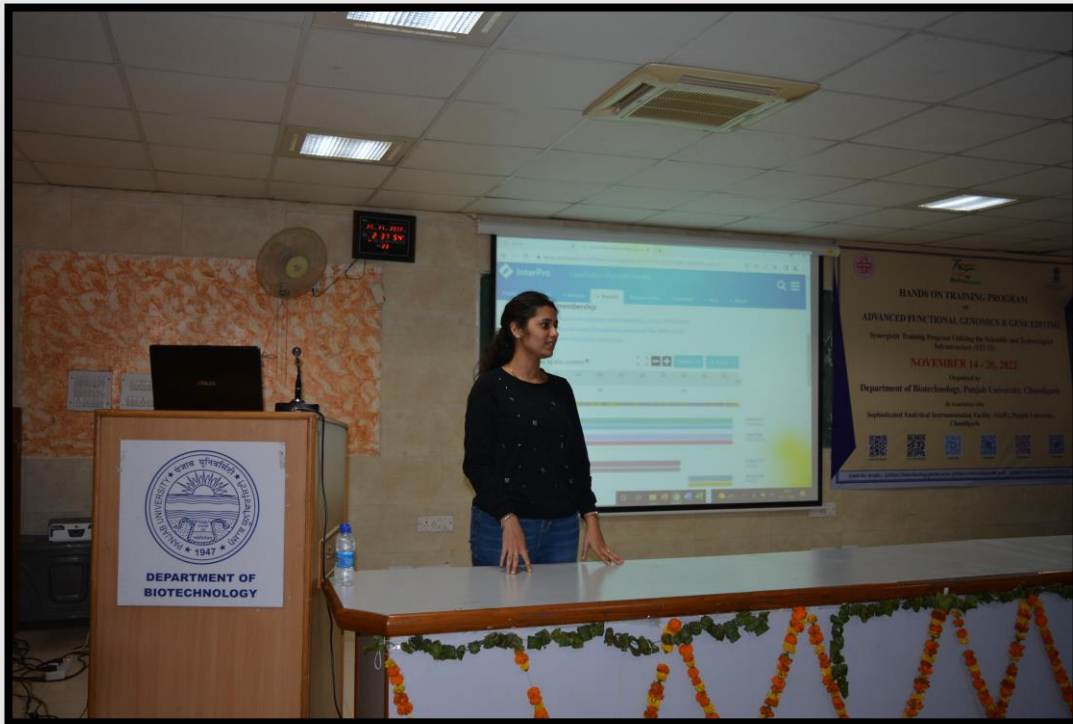


The day 2 of the STUTI Training Program started with the expert talk on the role of MpDUSP12- miRNA8185 module on *Marchantia polymorpha* sexual reproductive success by Dr. Halina Pietrykowska, Senior Specialist, Department of Gene Expression, AMU, Poland. She presented her research work on the identification and characterization of miRNAs in sexual reproduction of *M. polymorpha*. Participants get aware of the miRNA & target module along with their potential role in post-transcriptional regulation. The response of the participants was very good.



## DAY 2

During the second half, hands-on training was imparted on genome-wide identification and characterization of gene families. Participants were engaged in practical hands-on experience with different bioinformatics tools used to characterize the different gene families.



## DAY 3

Day 3 started with the talk of Dr. Kumardeep Chaudhary, Senior Scientist, CSIR-IGIB, New Delhi, on applications of artificial intelligence in biological sciences. The Machine learning (ML), a subset of AI used to handle volume, velocity, variety and veracity of big data to get meaningful interpretation was discussed with the participants. He further discussed established experimental and evolving computational methods to identify non-coding regions and genes. During the second session, the practical hands-on training was imparted to the participants on global identification of miRNA (novel & conserved) and their characterization.





## DAY 4

Day 4 started with the visit to NABI, Mohali where Dr. Siddharth Tiwari delivered a talk on applications and regulations of genome editing in traits improvement in plants. He gave a comprehensive talk on gene editing technique such as CRISPR/Cas9 technology.



Post lunch session started with the talk of Dr. Sudhir P. Singh on metagenomic investigations for discovery and characterization of novel genes for biocatalytic production of functional sugars of rare occurrence. Talk provided detailed information on generation of metagenomic resources from the extreme habitats to identify novel genes.

## DAY 5

Day 5 of the DST supported STUTI program started with the lecture on multi-target genome editing by Dr. Rupesh Deshmukh, Ramalingaswami Fellow (Associate Professor) Plaksha University, Mohali. The basics of multi-target genome editing and its applications in tomato and soybean were discussed by the expert. An interactive session took place between the expert and participants. Various doubts of the participants were covered by the experts.



After the lecture, the practical hands-on training was imparted to the participants on the basics of CRISPR/CAS technology such as single guide-RNA (sgRNA) designing and preparation using online tools, vector selection and digestion followed by the doubts and queries.



## DAY 5

Post lunch session is started with a talk of Dr. Nitin Singhal, NABI, Mohali, on development of nano biosensors for the microbial detection based on CRISPR/CAS system. An interactive session took place between the expert and participants. Various doubts of the participants were covered by the experts.



**Hands on training session**



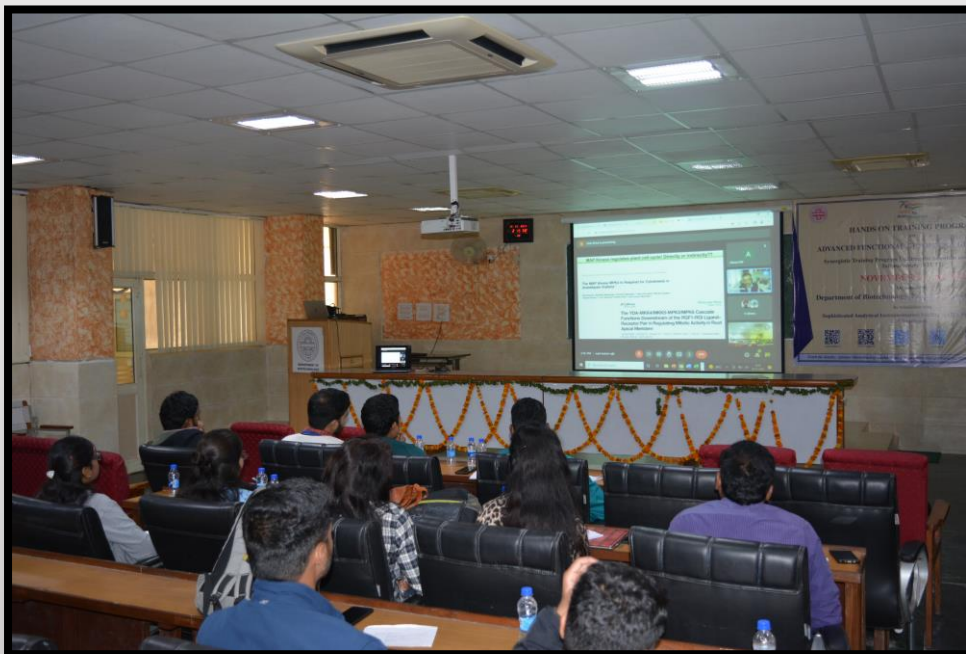


## DAY 6

An expert lecture on applications of CRISPR/CAS tools for enhancing the nutritional value of food crops by Dr. Ashutosh Pandey, Staff Scientist-III, NIPGR, New Delhi. An overview of recent comprehensive advancements in CRISPR/Cas9 system and its exciting applications in crop improvements was discussed by the expert.

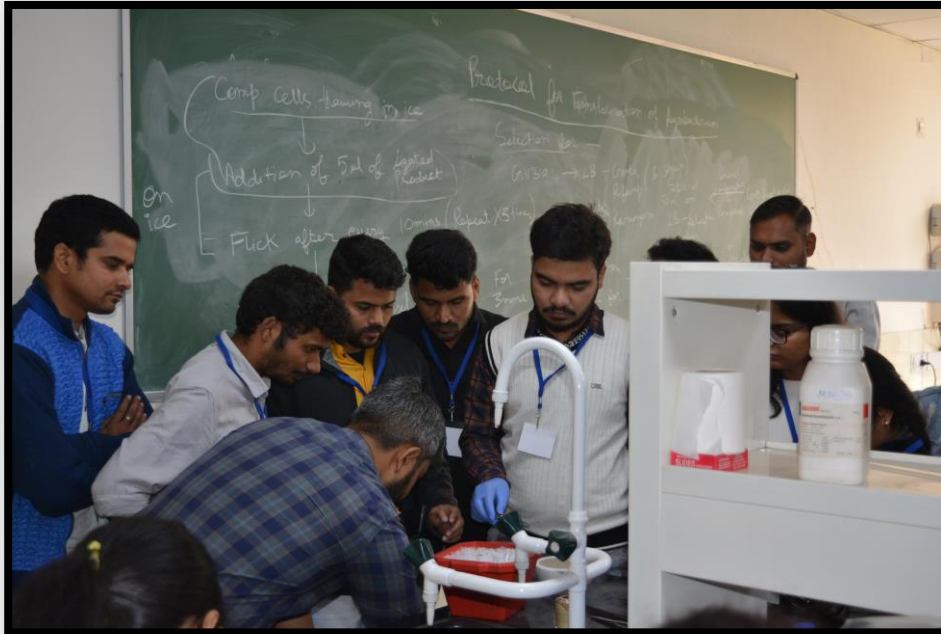
After the lecture, the practical hands-on training was imparted to the participants on CRISPR/CAS gene editing which included DNA oligo duplex preparation.

Post lunch session started with a talk of Dr. Alok K Sinha, NIPGR, New Delhi on MAP kinase cascade-mediated regulation of cell cycle in rice. An interactive session took place between the expert and participants.



## DAY 6

After the lecture, the practical hands-on training was imparted to the participants which included transformation of gRNA cassette and Cas9 into the *Agrobacterium*.



## DAY 7

On the seventh day of the DST STUTI training program, the talk on synthetic biology was given by the Dr. Shashi Kumar Rhode, Group Leader ICGEB, New Delhi. A detailed discussion on applications of synthetic biology in photosynthetic organisms for value-added products such as delivery of artemisinin took place.



After the lecture, the practical hands-on training was imparted to the participants.



Post lunch session started with the talk of Dr. Arun Kumar, Senior Scientist, CSIR-IHBT, Palampur on plant pathogen interaction at the molecular level. He also discussed about the rice-*R. solani* AG1-IA interactions to develop sheath blight resistance in rice



After the lecture, the practical hands-on training was imparted to the participants which included *Agrobacterium*-mediated transformation of gRNA cassette and Cas9 into the potato.



## DAY 8

On the eighth day of the DST STUTI training program, the talk on molecular and genomic approaches including CRISPR/Cas9, RNAi was given by the Dr. Ajay Pandey, NABI, Mohali. A detailed discussion on applications of gene editing technologies to improve the micronutrient bioavailability and content in the developing grains of wheat took place.



The second talk was on the importance of genetic improvement of plants delivered by Dr. Saravjeet Singh Gill, Assistant Professor, MDU, Haryana.



## VALEDICTION

During the Valediction ceremony, the feedback of the participants, felicitation and certificate distribution took place.

Participants felt motivated and appreciated the efforts of the organizing committee of the Department of Biotechnology, PU, Chandigarh for training and hands on experience.

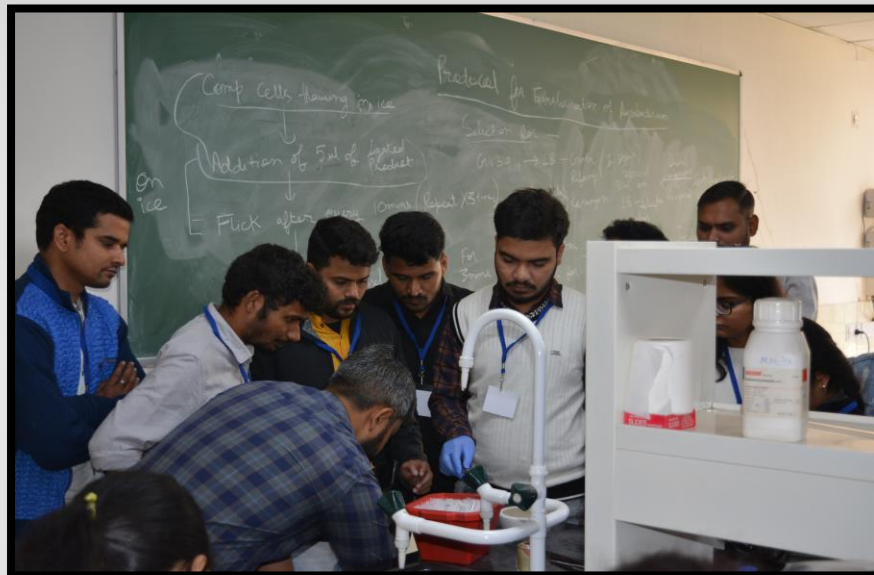
Participants were thankful to the DST, Government of India, for creating platform where scientific knowledge and hands-on training of high-end instruments can be accessed easily.





## GLIMPSES OF TRAINING PROGRAM







## **LIST OF PARTICIPANTS**

<b>Name</b>	<b>Designation</b>	<b>Affiliation</b>	<b>State</b>
Agnita Sharon	Research Scholar	Zoological Survey of India, Southern Regional Centre	Tamil Nadu
Arti Kumari	Research Scholar	Department of Zoology, BNMU	Bihar
Astha Gupta	Assistant Professor	Shardha University	U.P
Parul Singh	Research Scholar	Department of Biotechnology, PU	Chandigarh
RANJANA	Scientist	Zoological Survey of India, Southern Regional Centre	Tamil Nadu
Ritisha Singh	Student	BBAU	UP
Shagun Sharma	Research Scholar	Gurukul Kangri University	Uttrakhand
Shraddha Mohanty	Student	BHU	Varanasi
Tripti Sharma	Research Scholar	Shardha University	U.P
Swati Mangla	Research Scholar	MDU	Haryana
Monika Yadav	Research Scholar	Kurukshetra University	Haryana
Preeti	Research Scholar	Department of Biochemistry, PU	Chandigarh
Muskan	Research Scholar	Akal University	Punjab
Murali Sharaff	Assistant Professor	Charotar University of Science & Technology	Gujarat
Pushpendra	Research Scholar	SVPUAT	U.P
Rakesh Kr Patra	Research Scholar	Ramakrishna Mission Vivekananda Centenary College	West Bengal
S. Viswanathan	Post Doc Fellow	Bharathiar University	Tamil Nadu
Saima Amjad	Young Scientist	DHR-ICMR KGMU	U.P

Suman Parre	Assistant Professor	Centurion University of Technology and Management	Odisha
Tanwir Alam	Research Scholar	Department of Physics, BNMU	Bihar
Avik Sarkar	Research Scholar	Ramakrishna Mission Vivekananda Centenary College	West Bengal
Mora Tulasiram	Project Assistant	University of Hyderabad	Telangana
Dipesh Kale	Research Scholar	AIIMS	Madhya Pradesh
Akshay Shendekar Siddhanath Ajinath	Research Scholar	MPKV	Maharashtra
Arun Kumar Shaw	Research Associate	University of Kalyan	West Bengal
Ashutosh Shukla	Research Scholar	CSJM University	Kanpur
Bhaskar Chandra Sahoo	Research Scholar	Siksha 'O' Anusandhan University	Odisha
Neha Guleri	Research Scholar	Central University of H.P	H.P
Aiana	Research Scholar	PU	Chandigarh
Nandni Goyal	Research Scholar	PU	Chandigarh
Jaishree	Research Scholar	PU	Chandigarh
Rinku Balhara	Research Scholar	PU	Chandigarh





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