

**Minutes of the
20th Meeting of the Board of Studies
of
Department of Botany
Central University of Jammu**



Venue: Online via Google Meet

Date: 12th June, 2025

Time: 3:00 PM

Ally Sh

Prakash Sharma

[Handwritten signatures]

20th meeting of the Board of Studies, Department of Botany, Central University of Jammu was held on 12th June, 2025 in the online mode using Google Meet at 3:00 PM. Following members attended the meeting:

S. No.	Name of the member	Affiliation
1.	Dr. Yogesh Kumar (Chairperson and HOD)	Head, Dept. of Botany, CUJ
2.	Prof. Namrata Sharma (External Expert)	Professor. Dept. of Botany, University of Jammu
3.	Prof. B.S. Bhau (Member)	Professor, Dept. of Botany, CUJ
4.	Prof. Uday Pratap Singh (Special Invitee)	Associate Dean Academics, CUJ
5.	Dr. Deepak Bhardwaj (Member)	Associate Professor, Dept. of Botany, CUJ
6.	Dr. Shweta Yadav (Member)	Assistant Professor, Department of Environmental Studies, CUJ
7.	Dr. Ashok Kumar (Member)	Assistant Professor, Dept. of Botany, CUJ

Prof. Suram Singh (Dean Academics, CUJ) was also invited to attend the meeting but was unable to do so due to some prior commitments.

Following are the point-wise minutes of the meeting:

1. Opening remarks by the Chair.

The Chairperson extended a warm welcome to the respected external expert and all members present. He initiated the meeting with his opening remarks.

2. To consider and revise the course structure of the Integrated B.Sc.–M.Sc. Botany programme (NEP batches), aligning them with the UGC Credit Framework and the University Guidelines.

The proposed revision of the course structure for the Integrated B.Sc.–M.Sc. Botany programme, aligning it with the UGC Credit Framework for 3-year and 4-year UG programmes, as well as with the latest University Guidelines, was presented. After discussion, the Board members approved the proposed revision with a consensus. The revised course structure is as follows:

AS

Kishan

Shuk

[Signature]

[Signature]

Sem.	Major (Core) [Th (3) + Pr (1)]	Minor Stream [Th (4)]	MD / OE Course	AEC	SEC	VAC [Th (1) + Pr (1)]	Credits
I	Plant Kingdom: Diversity in Forms, Structure and Reproduction IBOT1C001T (3+1)	Principles of Biochemistry (4)	OE (4)	AEC (3)	Tools and Techniques in Biochemical Sciences (2+1)	Gardening and Biofertilizers (1+1)	20
II	Economic Botany IBOT1C005T (3+1)	Basics of Cell Biology (4)	OE (4)	AEC (3)	Plant Cell Biology and Analytical Methods (2+1)	Organic Farming and Vermicomposting (1+1)	20
<p><i>Students exiting the programme after securing 40 credits will be awarded UG Certificate in the Discipline / Subject provided they secure 4 credits in work-based vocational courses offered during summer term or internship / apprenticeship in addition to 6 credits from skill-based courses earned during first and second semester</i></p>							
III	Archegoniates and Angiosperms (3+1)	Cytology and Cytogenetics (4)	OE (4)		Experimental Microbiology (1+1)	Herbal Cosmetics and Natural Products Formulation (1+1)	20
	Fundamentals of Phycology (3+1)						
IV	Fundamentals of Mycology (3+1)	Basics of Plant Metabolism (4)		AEC (2)	Summer Internship (2)		20
	Fundamentals of Genetics (3+1)	Environmental Studies (4)					
<p><i>Students exiting the programme after securing 80 credits will be awarded UG Diploma in the Discipline / Subject provided they secure 4 credits in work-based vocational courses offered during first year or second year summer term.</i></p>							
V	Taxonomy and Systematics (3+1)	Fundamentals of Molecular Biology (4)					20
	Reproductive Biology of Plants (3+1)	Biostatistics (4)					
	Plant Anatomy (3+1)						
VI	Plant Physiology (3+1)	Molecular Systematics (4)					20
	Introduction to Plant Biotechnology (3+1)						
	Plant Ecology (3+1)	Introduction to Bioinformatics (4)					

NUS Sh

[Handwritten signatures]

[Handwritten signature]

[Handwritten signature]

[Handwritten signature]

Students who want to undertake 3-year UG programme will be awarded UG Degree in the Discipline / Subject upon securing 120 credits

UG Degree (Honours)						
VII	Phycology, Bryology and Pteridology (3+1)	Plant Molecular Physiology, Biochemistry and Metabolic Engineering (4)				20
	Gymnosperms and Paleobotany (3+1)					
	Developmental Biology of Angiosperms (3+1)	Research Methodology (4)				
VIII	Molecular Cell Biology (3+1)	In vitro Technologies in Plants (4)				20
	Cellular and Molecular Genetics (3+1)	Ecology and Biodiversity Conservation (4)				
	Mycology and Phytopathology (3+1)					

UG Degree (Honours with Research)

VII	Phycology, Bryology and Pteridology (3+1)	Plant Molecular Physiology, Biochemistry and Metabolic Engineering (4)				20
	Gymnosperms and Paleobotany (3+1)					
	Developmental Biology of Angiosperms (3+1)	Research Methodology (4)				
VIII	Molecular Cell Biology (3+1)			Research Project /Dissertation (12)		
	Mycology and Phytopathology (3+1)					

Students will be awarded UG Degree (Honours) / UG Degree (Honours with Research) in the Discipline / Subject, provided they secure 160 credits

MD: Multidisciplinary; OE: Open Elective; AEC: Ability Enhancement Course; SEC: Skill Enhancement Course; VAC: Value-added Course; LTP: Lecture, Tutorial, Practical)

Handwritten signatures and initials: NSG, [Signature], [Signature], [Signature], [Signature]

3. To consider and revise the contents of Sem-I and Sem-II courses of the Integrated B.Sc.-M.Sc. Botany programme (NEP batches), aligning them with the revised course structures.

A proposal was presented for the revision of course contents for Sem-I and Sem-II of the Integrated B.Sc.-M.Sc. Botany programme (NEP batches), in accordance with the UGC Credit Framework and prevailing University Guidelines. The proposed structure included some courses which were previously approved in earlier meetings of the Board of Studies, and some new courses were also designed (for which course codes are not mentioned). The detailed contents of the newly designed courses were provided in *Annexure-I*. The revised structure will be implemented from the Academic Session 2025-26 onwards. After deliberation, the Board members approved the revised course titles and contents. The revised course structure for Sem-I and Sem-II is as follows:

Sem.	Major (Core) [Th (3) + Pr (1)]	Minor Stream [Th (4)]	MD / OE Course	AEC	SEC [Th (2) + Pr (1)]	VAC [Th (1) + Pr (1)]	Credits
I	Plant Kingdom: Diversity in Forms, Structure and Reproduction IBOT1C001T (LTP: 3-0-2)	Principles of Biochemistry (LTP: 4-0-0)	OE (4 Credits)	AEC-1 (3 credits)	Tools and Techniques in Biochemical Sciences (LTP: 2-0-3)	Gardening and Biofertilizers (LTP: 1-0-2)	20
II	Economic Botany IBOT1C005T (LTP: 3-0-2)	Basics of Cell Biology (LTP: 4-0-0)	OE (4 Credits)	AEC-2 (3 credits)	Plant Cell Biology and Analytical Methods (LTP: 2-0-3)	Organic Farming and Vermicomposting (LTP: 1-0-2)	20

List of Open Elective Courses offered by the Department

S. No.	Course Name	Course Code	L-T-P	Credits
1	Introduction to Plant Biology*	IBOT1O001T	4-0-0	4
2	Vermicomposting and Mushroom Farming	IBOT1O002T	4-0-0	4
3	Climate Change and Disaster Management	IBOT1O003T	4-0-0	4
4	Biostatistics and R-programming	IBOT1O004T	4-0-0	4
5	Applied Botany*	To be assigned	4-0-0	4
6	Fundamentals of Bioinformatics*	To be assigned	4-0-0	4
7	Agriculture, Monsoons and Rural Development	To be assigned	4-0-0	4

Students exiting the programme after securing 40 credits will be awarded UG Certificate in the relevant Discipline / Subject provided they secure 4 credits in work-based vocational courses offered during summer term or internship / apprenticeship in addition to 6 credits from skill-based courses earned during first and second semester.

MD: Multidisciplinary; OE: Open Elective; AEC: Ability Enhancement Course; SEC: Skill Enhancement Course; VAC: Value-added Course; LTP: Lecture, Tutorial, Practical

*The star-marked courses are not available to be taken by the Integrated B.Sc.-M.Sc. Botany students

4. To consider and approve the list of MOOC courses to be recommended to the students of the Integrated B.Sc.-M.Sc. Botany programme for the odd semester of the Academic Session 2025-26.

The Department proposed a list of MOOC courses recommended for students enrolled in the Integrated B.Sc.-M.Sc. Botany programme. This will ensure that the MOOCs undertaken, for

Handwritten signatures and initials are present at the bottom of the page, including "NLS Sh" and "Kish".

which credits will be counted towards a degree in Botany, are aligned with the relevant domain. The Board members reviewed these courses thoroughly, and following MOOCs to be recommended to the students were finalized:

S. No.	Name of the Course	Course Code	Platform	Duration
1	Food Oils and Fats: Chemistry and Technology	noc25-ag16	NPTEL	12 Weeks
2	Soil Fertility and Fertilizers	noc25-ag19	NPTEL	12 Weeks
3	NMR Spectroscopy for Structural Biology	noc25-cy38	NPTEL	12 Weeks
4	Fundamentals of Cryo-Electron Microscopy (Cryo-EM) and 3D Image Processing in Structural Biology	noc25-bt47	NPTEL	12 Weeks
5	Industrial Biotechnology	noc25-bt56	NPTEL	12 Weeks
6	Introduction to Proteogenomics	noc25-bt71	NPTEL	12 Weeks
7	Next Generation Sequencing Technologies: Data Analysis and Applications	noc25-bt81	NPTEL	12 Weeks
8	Fundamentals of Protein Chemistry	noc25-cy57	NPTEL	12 Weeks
9	Bacteriology and Virology	cec25_bt16	CEC	12 Weeks
10	Industrial Microbiology and Immunology	cec22_bt18	CEC	12 Weeks
11	Foundations of R Software	noc25-ma99	NPTEL	12 Weeks
12	Organic Chemistry in Biology and Drug Development	noc25-cy58	NPTEL	12 Weeks
13	Plant Pathology and Soil Health	cec25_bt06	CEC	12 Weeks

Note: Each of these courses will be considered as carrying four (4) credits.

5. To ratify the minutes of the Ph.D. Research Advisory Committee (RAC) meetings held in May/June 2025.

RAC meetings of the Ph.D. scholars in the Department of Botany were held in May/June 2025 as detailed below:

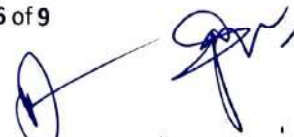
S. No.	Scholar Name	Supervisor	Date
1	Anuj Guleria	Dr. Vikas Srivastava	22 nd May, 2025
2	Shreya Proach	Prof. B.S. Bhau	26 th May, 2025
3	Diksha Bagal	Dr. Vikas Srivastava	26 th May, 2025
4	Chahat Slathia	Dr. Yogesh Kumar	27 th May, 2025
5	Vrinda Sharma	Dr. Samantha Vaishnavi	30 th May, 2025
6	Akshu Jasrotia	Dr. Yogesh Kumar	30 th May, 2025
7	Isha Kumari	Dr. Ashok Kumar	30 th May, 2025
8	Jyoti Priya Samantaray	Dr. Deepak Bhardwaj	2 nd June, 2025
9	Barkha Parihar	Prof. B.S. Bhau	11 th June 2025

Please read as 30th May 2025

 (Chairperson)









The minutes of the meetings (placed in Annexure-II) were discussed with the Board members, who reviewed the meeting minutes and recommended further necessary actions based on the discussions.

6. **To consider and approve the course structure of the Minor Degree programme for undergraduate students, to be offered exclusively through online platforms, beginning from the Academic Session 2025-26 onwards.**

The Department had proposed offering a Minor Degree programme in "Genetics" for undergraduate students in the 19th BOS meeting. It was proposed to change the name of this minor degree to "Genetics, Cytogenetics and Genomics" to reflect the rapidly advancing field, which has become integral to the study of genetics. The programme aims to provide students with an opportunity to broaden their academic horizon beyond their primary field of study. To qualify for this minor degree, students are required to complete additional credits, accounting for at least 15-20% beyond the total credits of their major degree. The courses of the minor degree will be offered exclusively through online platforms, beginning from the Academic Session 2025-26 onwards.

The Department proposed the course structure for this Minor Degree programme (as detailed below), which was discussed with the Board members. The Board approved the following course structure for this Minor Degree Programme and recommended its implementation in the upcoming academic session.

S. No.	Course Title	Course Code	Duration	Recommended Semester
1	Basic Genetics	ini25_bt11	12 weeks	II
2	Cytogenetics	cec25_bt13	12 weeks	III
3	Genetics and Genomics	cec25_bt01	12 weeks	IV
4	Computational Genomics	noc24_bt03	12 weeks	V
5	Introduction to Proteogenomics	noc25-bt71	12 weeks	VI

Note: The list of courses under the Minor Degree Programme will be reviewed in each meeting of the Board of Studies (BOS). In case any course is discontinued or not offered in a particular semester, it will be replaced by an equivalent course as recommended by the BOS. **Each of these courses will be considered as carrying four (4) credits.**

7. **To consider and approve the course structure and contents of the "Plant Tissue Culture" Certificate Course, to be offered by the Department for students holding an undergraduate degree.**

The Department presented the course structure and contents of a 20-credit certificate course "Plant Tissue Culture", as proposed in the 19th BOS meeting. The course is intended to provide students with in-depth theoretical knowledge and hands-on training in plant tissue culture techniques, thereby enhancing their industry-relevant competencies and improving their employability. After review and discussion, the Board members approved the proposed course structure and syllabus for implementation in the upcoming academic session. The detailed syllabus is placed in Annexure-III, and the course structure is as follows:

MSB

[Handwritten signature]

[Handwritten signature]

[Handwritten signature]

[Handwritten signature]

[Handwritten signature]

[Handwritten signature]

Course structure the "Plant Tissue Culture" Certificate Course

S. No.	Course Name	L-T-P	Credits
1.	Principles and Foundations of Plant Tissue Culture	4-0-0	4
2.	Culture Techniques in Plant Tissue Culture	4-0-0	4
3.	Micropropagation and Hardening Techniques	4-0-0	4
4.	Advanced Methods in Plant Tissue Culture	4-0-0	4
5.	Plant Haploids and Transformation Techniques (Lab)	0-0-4	2
6.	Applied Techniques in Plant Micropropagation and Hardening (Lab)	0-0-4	2
Total Credits			20

Note: The student may opt for any one of the theory courses (S. No. 1 to 4) through MOOCs, provided it is equivalent to the corresponding offline course and approved by the Department.

8. To revise the course structure of the Ph.D. Botany Coursework from the Academic Session 2025–26 onwards.

The Department proposed a revision to the existing Ph.D. coursework in Botany, which currently comprises 16 credits. To provide students with additional time to focus on their research work, it was proposed to reduce the credit requirement to 12 credits. Furthermore, it was proposed that students be allowed to complete all coursework requirements through **approved MOOC platforms**. The revised course structure was presented to the Board for consideration. In addition, the Department proposed the introduction of two new **Open Elective Courses** "Molecular Mechanisms of PGPR-Plant Interactions" and "Plant-Microbe Interactions." These courses are intended to broaden the interdisciplinary learning opportunities available to research scholars. The detailed course contents were placed in **Annexure-IV**. After due discussion, the Board approved the revised Ph.D. coursework structure and the inclusion of the two new Open Elective courses in the existing basket. The revised course structure is as follows:

Course Code	Course Title	Credit	ESE	Max. Marks
COMPULSORY / CORE COURSE				
PHUNI1C001T	Research and Publication Ethics (RPE)	2	50	50
PHUNI1C002T	Research Methodology	4	100	100
PBOT1C001T	Techniques in Biological Research	2	50	50
OPTIONAL / OPEN ELECTIVE COURSES (ANY ONE)				
#	Open Elective Course	4	100	100
Total		12	-	300

MSB
 [Handwritten signatures and initials]
 Page 8 of 9

List of Optional / Open Elective Courses offered by the Department of Botany				
Course Code	Course Title	Credit	ESE	Max. Marks
PBOT1O001T	Plant Cell Signalling and Behaviour	4	100	100
PBOT1O002T	Plant Stress Biology	4	100	100
PBOT1O003T	Plant Tissue Culture and Secondary Metabolism	4	100	100
PBOT1O004T	Plant Molecular Genetics	4	100	100
PBOT1O005T	Molecular Markers and their Applications	4	100	100
PBOT1O006T	Ethnobotany	4	100	100
PBOT1O007T	Advanced Plant Virology	4	100	100
PBOT1O008T	Perspectives in Plant Diversity	4	100	100
To be assigned	Molecular Mechanisms of PGPR-Plant Interactions	4	100	100
To be assigned	Plant-Microbe Interactions	4	100	100

Note: Any or all of the Core/Open Elective courses may be opted from MOOCs, recommended by the Department and/or the University.

9. Any other item (with the permission of the chair).


No other agenda item was discussed in the meeting.

10. Vote of thanks

The chairperson formally extended a vote of thanks to conclude the meeting.



Dr. Yogesh Kumar (Chairperson and HOD)




Prof. Namrata Sharma (External Expert)



Prof. Uday Pratap Singh (Associate Dean Academics)



Prof. B.S. Bhau (Member)



Dr. Deepak Bhardwaj (Member)



Dr. Shweta Yadav (Member)



Dr. Ashok Kumar (Member)

Principles of Biochemistry

LTP: 4-0-0

Credits: 4

Course Objectives:

This course aims to provide students with an understanding of biomolecules, with emphasis on their structural foundations, unique properties, biological roles, and inter-relationships. The focus is on the structural and functional relationships of carbohydrates, lipids, proteins, nucleic acids and related biomolecules at the molecular level from a biological perspective.

Learning Outcomes:

After successful completion of this course, students will be able to:

1. Describe the chemistry and structural diversity of carbohydrates, lipids, and proteins.
2. Understand the classification, biological roles, and interactions of major biomolecules.
3. Interpret the structural properties of proteins using tools like the Ramachandran plot.
4. Explain biomolecular interactions that underlie enzyme action, membrane dynamics, and metabolic regulation.
5. Analyse the structure and functions of nucleotides, DNA, and major RNA species, including their biological roles and molecular diversity.

Theory

Unit 1: Introduction to Biochemistry and Water

Definition and scope of biochemistry; cellular and chemical foundations of life. Covalent and non-covalent interactions in biomolecules – hydrogen bonding, ionic interactions, van der Waals forces, and hydrophobic interactions. Unique properties of water; weak interactions in aqueous systems; ionization of water and pH; buffering action in biological systems. Water as a universal solvent and reactant; biological significance of aqueous environments.

Unit 2: Carbohydrates

Structure of monosaccharides – aldoses and ketoses; ring structures and conformations; mutarotation, anomers, epimers, enantiomers. Biologically important sugar derivatives; oxidation and reduction of sugars. Structure and function of disaccharides (reducing and non-reducing). Classification and function of polysaccharides – homo- and heteropolysaccharides; structural and storage forms. Glycoconjugates: proteoglycans, glycoproteins, and glycolipids (gangliosides and lipopolysaccharides). Carbohydrates as informational molecules.

Unit 3: Amino Acids and Proteins

Classification and structural features of amino acids; physical and chemical properties; acid-base behaviour, titration curves, and isoelectric point. Uncommon amino acids and their biological roles. Protein structure: primary, secondary (α -helix, β -sheet), tertiary, and quaternary organization. Ramachandran plot – interpretation and significance in predicting protein folding; protein motifs and domains; denaturation and renaturation of proteins. Enzymes: Classification and mode of action.

MSH







Unit 4: Lipids

Classification and biological significance of lipids. Building blocks: fatty acids, glycerol, ceramide. Storage lipids – triacylglycerol and waxes. Structural lipids in membranes: glycerophospholipids, galactolipids, sulpholipids, ether lipids, sphingolipids, and sterols. Role of plant steroids. Lipids as signaling molecules, cofactors, and pigments.

Unit 5: Nucleotides and Nucleic Acids

Nucleotides: Structure and properties of bases; pentoses; nucleosides and nucleotides. Other functions of nucleotides: source of energy, components of coenzymes and secondary messengers. Watson-Crick model of DNA; forms and structure of DNA; structures of major RNA species: mRNA, tRNA and rRNA. Diverse functions of RNA.

Suggested Readings:

1. Nelson, D.L., & Cox, M.M. (2017). Lehninger Principles of Biochemistry (7th Edition). W.H. Freeman and Company.
2. Berg, J.M., Tymoczko, J.L., Gatto, G.J., & Stryer, L. (2019). Biochemistry (9th Edition). W.H. Freeman and Company.
3. Campbell, M.K., & Farrell, S.O. (2011). Biochemistry (7th Edition). Cengage Learning.
4. Satyanarayana, U., & Chakrapani, U. (2020). Biochemistry (5th Edition). Elsevier India.
5. Voet, D., & Voet, J.G. (2016). Biochemistry (4th Edition). Wiley.

Supplementary Resources:

1. Protein Data Bank – <https://www.rcsb.org>
2. ExPASy Bioinformatics Portal – <https://www.expasy.org>
3. PubChem – <https://pubchem.ncbi.nlm.nih.gov>
4. NCBI Bookshelf – <https://www.ncbi.nlm.nih.gov/books>

14/5/20









Basics of Cell Biology

LTP: 4-0-0

Credits: 4

Course Objective:

This course aims to provide students with a foundational understanding of cell biology, focusing on the structure, function, and organization of prokaryotic and eukaryotic cells. It introduces key cellular components such as biomembranes, organelles, and chromatin, and explores their roles in maintaining cellular integrity and function. Emphasis is placed on the dynamic processes of the cell cycle, including mitosis and meiosis, and the regulatory mechanisms involved. The course also equips students with theoretical knowledge of microscopy and staining techniques to visualize and analyse cellular structures, fostering both conceptual understanding and practical skills relevant to cell biology.

Course Outcomes:

Upon successful completion of this course, students will be able to:

1. Describe the structural and functional organization of prokaryotic and eukaryotic cells.
2. Explain the structure, composition, and dynamics of biological membranes and transport mechanisms.
3. Interpret chromatin organization, types of nucleic acids, and the functional significance of the nucleus.
4. Analyse the stages and regulatory mechanisms of mitosis, meiosis, and the cell cycle.
5. Apply principles of microscopy and staining techniques to observe and interpret cellular structures and processes.

Theory**Unit 1: Cell Structure and Organization**

Historical background of cell biology and development of cell theory, comparison between prokaryotic and eukaryotic cells, structure and basic functions of plasma membrane and cytoplasm, introduction to cytoskeletal elements: microtubules, microfilaments, and intermediate filaments, overview of major organelles (structure and functions): nucleus, mitochondria, chloroplasts, endoplasmic reticulum, Golgi apparatus, lysosomes, peroxisomes, and ribosomes, structure and function of the plant cell wall, basic differences between animal and plant cell organization.

Unit 2: Membranes and Transport

Structure of biological membranes: fluid mosaic model, basic composition of membrane lipids and proteins, membrane fluidity and asymmetry, overview of membrane transport processes: diffusion, osmosis, facilitated diffusion, and active transport, bulk transport mechanisms: endocytosis and exocytosis, basic understanding of membrane receptors and signal transmission.

11/5/22

Unit 3: Nucleus and Genetic Material

Structure of the nucleus: nuclear envelope, nuclear pores, and nucleolus, role of the nucleolus in ribosome formation, basic organization of chromatin: euchromatin and heterochromatin, structure and importance of nucleosomes, overview of chromosome structure and function, types and basic functions of DNA and RNA.

Unit 4: Cell Cycle and Division

Phases of the cell cycle: G₁, S, G₂, and M, basic concept of cell cycle regulation and checkpoints, introduction to cyclins and CDKs, stages and significance of mitosis and meiosis, comparison between mitosis and meiosis, concept of crossing over and genetic variation, introduction to apoptosis: key features and biological importance.

Unit 5: Cytological Techniques and Applications

Basic principles and types of microscopy: light, fluorescence, and electron microscopy, concepts of magnification, resolution, and numerical aperture, simple sample preparation and staining methods: methylene blue, acetocarmine, and Feulgen stain, applications of microscopy in studying cellular structures, introduction to micrometry, concept of plasmolysis and deplasmolysis, relevance of cytological techniques in cell biology and basic histological studies.

Suggested Readings:

Core Textbooks:

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments (6th Edition). Wiley.
2. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2015). Essential Cell Biology (4th Edition). Garland Science.
3. De Robertis, E.D.P., & De Robertis, E.M.F. Jr. (2001). Cell and Molecular Biology. Lippincott.
4. Verma, P.S., & Agarwal, V.K. (2018). Cell Biology. S. Chand Publishing.

Advanced References on Molecular and Applied Aspects:

1. Lodish, H., Berk, A., Kaiser, C.A., et al. (2016). Molecular Cell Biology (8th Edition). W.H. Freeman.
2. Becker, W.M., Kleinsmith, L.J., Hardin, J., & Bertoni, G.P. (2009). The World of the Cell (7th Edition). Pearson.
3. Cooper, G.M. & Hausman, R.E. (2013). The Cell: A Molecular Approach (6th Edition). Sinauer Associates.

Supplementary Online Resources and Journals:

ms8h

Q

Q

1. Molecular Biology of the Cell (Garland Science) – <https://www.routledge.com>
2. NCBI Bookshelf – <https://www.ncbi.nlm.nih.gov/books>
3. Journal of Cell Science – <https://jcs.biologists.org>
4. Nature Reviews Molecular Cell Biology – <https://www.nature.com/nrm>
5. Cell (Cell Press) – <https://www.cell.com>
6. The Journal of Cell Biology (Rockefeller University Press) – <https://jcb.rupress.org>
7. Plant Cell (American Society of Plant Biologists) – <https://academic.oup.com/plcell>
8. Annual Review of Cell and Developmental Biology –
<https://www.annualreviews.org/journal/cellbio>
9. iBiology (Video Lectures by Scientists) – <https://www.ibiology.org>
10. Cold Spring Harbor Perspectives in Biology – <https://cshperspectives.cshlp.org>
11. BioRender Learning Hub (for cell biology illustrations and visualization)
<https://learn.biorender.com>
12. HHMI BioInteractive (Animations and teaching materials) –
<https://www.biointeractive.org>
13. PubMed Central (Free access to full-text life science articles) –
<https://www.ncbi.nlm.nih.gov/pmc>
14. Frontiers in Cell and Developmental Biology –
<https://www.frontiersin.org/journals/cell-and-developmental-biology>
15. Cells (MDPI Open Access Journal) – <https://www.mdpi.com/journal/cells>

1/28/20







Tools and Techniques in Biochemical Sciences

Experimental Biochemistry

LTP: ~~1-0-4~~ 2-0-2

Credits: 3

Course Objective:

This course provides foundational knowledge of biochemical principles and develops practical laboratory skills essential for understanding the structure, properties, and quantification of biomolecules. Emphasis is placed on qualitative and quantitative biochemical techniques, preparation of reagents, and interpretation of experimental data.

Course Outcomes:

Upon successful completion of this course, students will be able to:

1. Demonstrate the ability to follow biochemical laboratory practices, accurately prepare solutions and buffers, and operate basic instruments such as pH meters, colorimeters, and spectrophotometers.
2. Perform and interpret qualitative and quantitative assays for biomolecules and enzymes, applying appropriate analytical techniques and understanding the biochemical basis of each test.

Theory**Unit 1: Biochemical Laboratory Practices and Instrumentation**

Overview of biochemical analysis and its applications; safety protocols and good laboratory practices in biochemistry labs; concepts of molarity, normality, and dilution; preparation of standard solutions and reagents; principles and preparation of buffers (e.g., phosphate, acetate); principles and operation of commonly used instruments such as pH meter, colorimeter, and spectrophotometer; concept and application of pH measurement; Beer-Lambert Law and its relevance in quantitative analysis; importance of blank, standard, and calibration curves in biochemical assays.

Unit 2: Qualitative and Quantitative Analysis of Biomolecules and Enzyme Assays

Theoretical basis and interpretation of qualitative tests for carbohydrates (Molisch's, Benedict's, Barfoed's, Seliwanoff's), proteins (Biuret, Millon's, Xanthoproteic, Ninhydrin), and lipids (Sudan III, saponification, acrolein test); chemical properties and functional groups of biomolecules; principles and procedures for quantitative estimation of glucose (DNS method), proteins (Lowry's or Bradford method), DNA (diphenylamine method), and enzymes (salivary amylase activity); basic principles of enzyme activity and kinetics; paper chromatography for separation of amino acids or sugars.

Practical

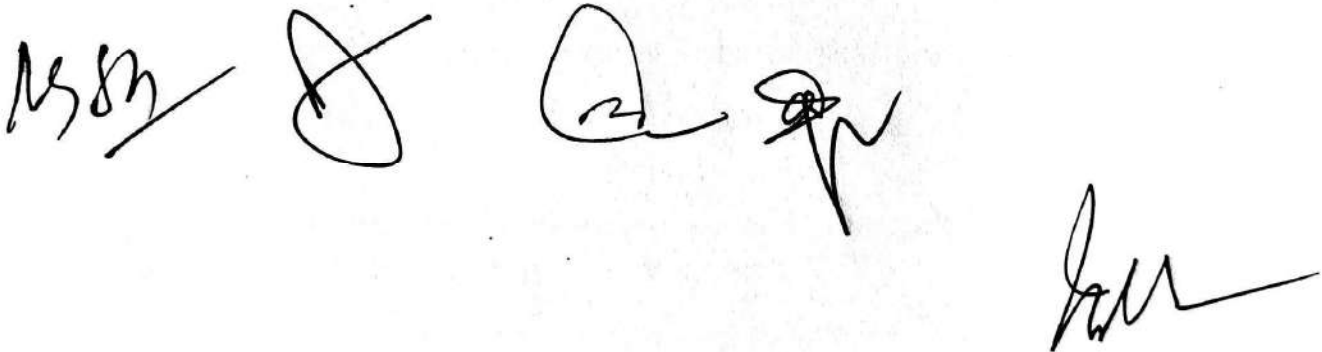
1. Preparation of standard solutions and buffers (e.g., phosphate, acetate).
2. Calibration and use of pH meter and colorimeter.
3. Qualitative tests for carbohydrates (Molisch's test, Benedict's test, Barfoed's test, Seliwanoff's test).

MSB

4. Qualitative tests for proteins (Biuret test, Millon's test, Xanthoproteic test, Ninhydrin test).
5. Qualitative tests for lipids (Sudan III, saponification, acrolein test).
6. Estimation of glucose by DNS (3,5-dinitrosalicylic acid) method.
7. Estimation of protein by Lowry's method or Bradford method.
8. Estimation of DNA by diphenylamine method.
9. Estimation of activity of an enzyme (e.g., salivary amylase activity).
10. Paper chromatography for separation of amino acids or sugars.

Suggested Readings

1. Plummer, D.T. (2017). An Introduction to Practical Biochemistry. Tata McGraw-Hill.
2. Sawhney, S.K., & Randhir Singh. (2012). Introductory Practical Biochemistry. Narosa Publishing House.
3. Jayaraman, J. (1981). Laboratory Manual in Biochemistry. New Age International.
4. Wilson, K., & Walker, J. (2010). Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press.



The image shows four distinct handwritten signatures or initials in black ink. From left to right: the first is 'MSM' with a diagonal slash; the second is a stylized circular mark with a vertical line; the third is a cursive signature that appears to be 'A. S.'; and the fourth is a long, horizontal cursive signature.

Gardening and Biofertilizers

LTP: 1-0-2

Credits: 2

Course Objective:

To equip students with practical skills in gardening and basic landscape design, train them in soil health management and nutrient application, teach field-based plant propagation techniques for diverse crops, and develop their ability to produce and apply biofertilizers for sustainable agriculture.

Course Outcomes:

Upon successful completion of the course, students will be able to:

1. Design and manage gardens using basic landscaping principles, assess soil health, and prepare sustainable nutrient mixes through organic and modern soil management practices.
2. Propagate plants through field-based techniques and apply biofertilizers effectively by understanding their types, benefits, production methods, and role in sustainable agriculture.

Theory

Unit 1: Gardening, Landscaping, and Soil Management

Importance of gardening in urban and rural settings; types of gardens (formal, informal, terrace, kitchen, institutional); basic landscaping principles (colour, texture, form, space) applied to garden design; gardening tools, maintenance, and sustainable practices such as water conservation and organic methods; modern trends including vertical gardening and smart irrigation systems.

Soil types, texture, structure, and pH; macro- and micronutrients essential for plant growth; preparation of soil mixes using organic amendments like compost; modern soil management techniques including biochar and no-dig gardening; digital tools for soil health assessment; sustainable nutrient management strategies.

Unit 2: Plant Propagation and Biofertilizer Technology

Seed propagation and vegetative methods: cutting, layering, grafting, and division; nursery bed preparation, sowing schedules, transplanting protocols, hardening of seedlings; low-cost field hydroponics; practical nursery management practices.

Definition, need, and classification of biofertilizers; mode of action and benefits of *Rhizobium*, *Azotobacter*, *Azospirillum*, phosphate-solubilizing bacteria (PSB), and vesicular-arbuscular mycorrhizae (VAM); comparison with chemical fertilizers; introduction to bionanofertilizers and microbial consortia; role in sustainable agriculture.

Techniques for isolation, culture, and formulation of microbial biofertilizers; types—liquid and carrier-based; application methods including seed treatment, soil inoculation, and foliar spraying; integration with precision agriculture; case studies on field applications.

Practical

MSM

[Handwritten signature]

[Handwritten signature]

[Handwritten signature]

1. Introduction to gardening tools and designing a garden layout with basic landscaping elements.
2. Identification and classification of ornamental, medicinal, and seasonal garden plants.
3. Soil testing: physical properties, pH measurement, and preparation of potting mixtures.
4. Sowing, transplanting, and maintenance of seasonal flowering and vegetable plants.
5. Propagation techniques: cutting, layering, division, and grafting (demonstration and practice).
6. Preparation and care of container gardens (pots, hanging baskets, vertical gardens).
7. Preparation of nursery beds and seedling trays; transplanting techniques.
8. Composting methods: pit composting, vermicomposting, and kitchen waste management.
9. Introduction to biofertilizers: types (*Rhizobium*, *Azospirillum*, *Azotobacter*, PSB, VAM) and their ecological roles.
10. Isolation and culture of *Rhizobium* from root nodules (demonstration).
11. Preparation of liquid and carrier-based biofertilizers; use of inoculants in gardening.
12. Application methods of biofertilizers: seed treatment, soil application, root dipping.
13. Comparison of plant growth using chemical fertilizers vs. biofertilizers (observation-based experiment).
14. Visit to an organic farm or nursery to observe large-scale gardening and biofertilizer practices.
15. Preparation and submission of practical record, garden project report.

Suggested Readings

Core Reading:

1. Ghosh, S.N. (2017). Gardening in India. ICAR Publications.
2. Acharya, K., Sen, S., Rai, M. (2024). *Biofertilizers and Biopesticides*. Scientific Publishers.
3. Kannaiyan, S. (2002). *Biofertilizers for Sustainable Agriculture*. Scientific Publishers.
4. TNAU AgriTech Portal – <https://agritech.tnau.ac.in>
5. NCOF Biofertilizer Manual – National Centre of Organic Farming, Ghaziabad.

Supplementary Online Resources:

1. ICAR-IARI Gardening Portal – <https://www.iari.res.in>
2. National Horticulture Board – <https://nhb.gov.in>
3. NCOF – <https://ncof.dacnet.nic.in>
4. Bora, T. (2021). *How Not To Kill Houseplants*. Penguin India.
5. Giri, B., et al. (2019). *Biofertilizers for Sustainable Agriculture and Environment*. Springer.
6. Fahad, S., et al. (2023). *Biofertilizers for Sustainable Soil Management*. CRC Press.

MSM

Organic Farming and Vermicomposting

LTP: 1-0-2

Credits: 2

Course Objective:

To provide students with foundational knowledge and practical exposure to the principles of organic farming, soil health management, composting systems, and the preparation and use of organic inputs, with an emphasis on sustainable, eco-friendly, and climate-resilient agricultural practices.

Course Outcomes:

Upon successful completion of the course, students will be able to:

1. Understand the principles of organic farming and soil health management, including the role of organic matter, crop diversification, and biofertilizers in sustainable agricultural systems.
2. Demonstrate knowledge of composting methods, vermiculture, and indigenous organic inputs, along with understanding certification processes and the role of organic farming in climate-resilient agriculture.

Theory

Unit 1: Principles of Organic Farming and Soil Health

Definition, principles, and objectives of organic farming; key differences between organic and conventional agriculture; ecological and socio-economic benefits of organic practices; global and Indian status of organic agriculture; soil as a living system; importance of organic matter; humus formation; nutrient cycling; green manures, cover crops, crop rotations, and intercropping; biofertilizers and microbial consortia in organic systems.

Unit 2: Composting, Organic Inputs, and Sustainability

Types of composting, including aerobic, anaerobic, pit, heap, and NADEP methods; principles and stages of composting; basics of vermiculture including biology of composting worms (*Eisenia fetida*), habitat requirements, and role in decomposition; preparation and applications of indigenous organic inputs such as Panchagavya, Jeevamrut, Beejamrut, fish amino acid, and bio-pesticides; certification requirements for organic inputs; organic certification processes in India (PGS-India, NPOP); labeling and traceability; challenges and opportunities in marketing organic produce; policies and support schemes; role of organic farming in climate-resilient agriculture.

Practical

1. Introduction to principles and components of organic farming.
2. Soil health assessment: organic carbon content and structure.
3. Compost pit preparation and organic waste segregation.

4. Introduction to vermiculture – species identification and biology of *Eisenia fetida*.
5. Setting up and managing a vermicompost unit.
6. Maintenance, watering, and harvesting of vermicompost.
7. Preparation of Panchagavya, Jeevamrut, and other organic formulations.
8. Application of compost and bio-inputs in field plots or pots.
9. Comparative study of organic vs. inorganic plot productivity.
10. Visit to an organic farm; submission of observations and report.

Core Textbooks:

1. Palaniappan, S.P., & Annadurai, K. (2007). Organic Farming: Theory and Practice. Scientific Publishers.
2. Sharma, A.K. (2006). A Handbook of Organic Farming. Agrobios (India).
3. Sinha, R.K., Heart, S., & Agarwal, S. (2002). The Wonders of Vermiculture. Indian Journal of Environmental Sciences.
4. Gaur, A.C. (2006). Recycling of Organic Wastes by Improved Methods. ICAR, New Delhi.

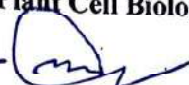
Supplementary Online Resources:

1. National Centre of Organic Farming – <https://ncof.dacnet.nic.in>
2. TNAU Organic Farming Portal – https://agritech.tnau.ac.in/org_farm/orgfarm_index.html
3. IFOAM Organics International – <https://www.ifoam.bio>

MSB
D
A
R

JMK

Plant Cell Biology and Analytical Methods

LTP: ~~1-0-4~~ 2-0-2 

Credits: 3

Course Objectives:

This course provides an integrated foundation in plant cell biology and experimental methods essential for studying plant structure, function, and biochemical analysis. It aims to develop both conceptual understanding and technical proficiency in microscopy, histological techniques, membrane biology, and modern plant laboratory practices. Emphasis is placed on understanding cellular organization, transport processes, and the use of key instruments and analytical methods for studying plant tissues at the cellular and molecular levels.

Course Outcomes:

Upon successful completion of this course, students will be able to:

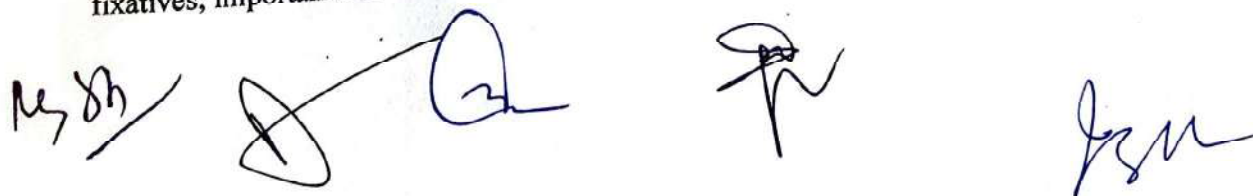
1. Explain the principles and applications of microscopy, histological techniques, and membrane biology in plant cells, while adhering to safe laboratory practices and proper documentation.
2. Demonstrate the use of analytical instruments and apply biochemical separation techniques such as chromatography and electrophoresis for plant cell and molecular analysis.

Theory**Unit 1: Microscopy, Histological Techniques, and Membrane Biology**

Basic principles of light and optics; structure and working of compound and dissecting microscopes; introduction to microscopy types: bright field, phase contrast, fluorescence; overview of SEM and TEM; applications of microscopy in plant anatomy and cell biology; laboratory safety protocols and chemical handling; identification and proper use of laboratory glassware and instruments; preparation of biological stains and fixatives; techniques of tissue embedding, sectioning using microtome, and double staining; mounting and preparation of permanent slides; fluid mosaic model of biological membranes; molecular composition and dynamics of membrane lipids and proteins; factors influencing membrane fluidity and asymmetry; passive transport, facilitated diffusion, and active transport mechanisms; osmosis and ion channels; bulk transport processes including phagocytosis, pinocytosis, receptor-mediated endocytosis, and exocytosis; overview of membrane receptors and signal transduction pathways.

Unit 2: Analytical Techniques, Biochemical Separation, and Sample Preservation

Principles and applications of spectrophotometry and colorimetry; preparation of standard curves for absorbance-based quantification; principles and operation of laboratory centrifuges; types and applications; chromatographic techniques: paper chromatography and thin-layer chromatography; electrophoresis: agarose gel-based DNA separation and concept of SDS-PAGE; preservation of plant specimens (algae to angiosperms) using chemical fixatives; importance of laboratory and field documentation.



Practical

1. Identification and handling of laboratory glassware and instruments.
2. Study and calibration of microscopes using ocular and stage micrometer.
3. Preparation of biological stains and fixatives.
4. Preparation of permanent slides using microtome and double staining.
5. Microscopic observation of cell organelles in onion peel and *Hydrilla* leaves.
6. Demonstration of plasmolysis and deplasmolysis using *Rhoeo* or *Tradescantia* leaves.
7. Use of haemocytometer to estimate cell number or size.
8. Estimation of membrane permeability using beetroot tissue.
9. Preparation of standard curve and absorbance-based quantification using spectrophotometer.
10. Separation of plant pigments by paper chromatography.
11. Electrophoretic separation of DNA using agarose gel.
12. Histological examination of preserved plant materials and laboratory documentation.

Suggested Readings:

1. Wilson, K., & Walker, J. (2018). Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press.
2. Skoog, D.A., Holler, F.J., & Crouch, S.R. (2017). Principles of Instrumental Analysis. Cengage Learning.
3. Plummer, D.T. (2017). An Introduction to Practical Biochemistry. McGraw-Hill Education.
4. O'Brien, T.P., Feder, N., & McCully, M.E. (1964). Polychromatic staining of plant cell walls. Stain Technology.
5. Sharma, B.K. (2005). Instrumental Methods of Chemical Analysis. Goel Publishing House.

Supplementary Resources:

1. NCBI Bookshelf – <https://www.ncbi.nlm.nih.gov/books>
2. ExPASy Bioinformatics Portal – <https://www.expasy.org>
3. Protein Data Bank – <https://www.rcsb.org>

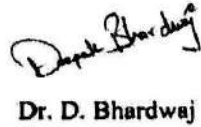
The bottom of the page features several handwritten signatures and initials in black ink. From left to right, there is a set of initials 'MSM', a large stylized signature, a smaller signature, another large stylized signature, and a final signature on the far right.

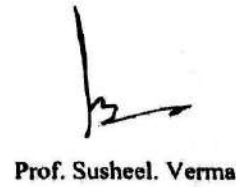
1. The meeting of Research Advisory Committee for Ms. Vrinda Sharma, Research Scholar, Department of Botany was held on 30-05-2025 at 10:30 am in the Office of the Head of Department via blended mode (Google Meet) to review the progress. The following members were present:

Dr. Yogesh Kumar	Associate Professor and Head, Dept. of Botany, CUJ	Chairman
Prof. Susheel Verma	Head, Department of Botany, University of Jammu, Jammu	External Expert
Dr. Deepak Bhardwaj	Associate Professor, Department of Botany, CUJ	Member
Dr. Samantha Vaishnavi	Assistant Professor, Department of Botany, CUJ	Member and Supervisor

2. The meeting began with a formal welcome note by the Chair.
3. Ms. Vrinda Sharma presented the work done by her during the past six months.
4. The RAC members noted that Ms. Vrinda Sharma's overall work progress was satisfactory. Work remaining is also under progress.
5. The meeting concluded with vote of thanks to the external expert and other members.

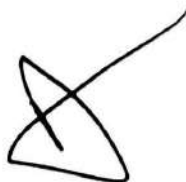

Dr. S. Vaishnavi
30/5/25


Dr. D. Bhardwaj


Prof. Susheel Verma


Dr. Yogesh Kumar
30/5/2025

MSM






Page 2 of 2





Central University of Jammu, Jammu
Departmental Research Committee / Research Advisory Committee

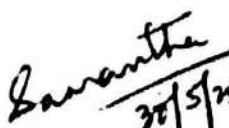
Department of Botany
 School of Life Sciences


Ph.D. Progress Report


DRC/RAC Recommendation:


Name of the Scholar	Ms. Vrinda Sharma
Name of the Supervisor	Dr. Samantha Vaishnavi
Title of Ph.D. thesis	Studies on genetic diversity of some selected <i>Ipomoea</i> L. species
Department/Centre	Botany
Name, Designation, Address of RAC members	
1. Dr. Yogesh Kumar, Associate Professor and Head, Department of Botany, CUJ	
2. Prof. Susheel Verma, Head, Department of Botany, University of Jammu, J&K (External expert)	
3. Dr. Deepak Bhardwaj, Associate Professor, Dept. of Botany, CUJ (Member)	
4. Dr. Samantha Vaishnavi, Assistant Professor, Department of Botany, CUJ (Supervisor)	
Duration of Progress	January 2025 – May 2025
Approximate %age of Research Work completed	85%
Good <input checked="" type="checkbox"/> Average <input type="checkbox"/> Satisfactory <input type="checkbox"/> Not Satisfactory <input type="checkbox"/>	
Remarks, if Any: Ms. Vrinda Sharma's overall work progress is found to be satisfactory. Work on the remaining objectives is also under progress.	

Signature of RAC Members

1.  20/5/25
 Dr. S. Vaishnavi


2. 
 Dr. D. Bhardwaj

3.  20/05/2025
 Dr. Yogesh Kumar

4. 
 Prof. S. Verma

 20/05/2025
 Dr. Yogesh Kumar

Name & Signature of Head




 Name & Signature of Dean




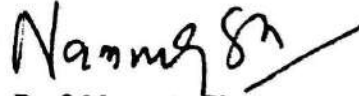
Minutes of the Meeting of Research Advisory Committee


1. The meeting of Research Advisory Committee (RAC) for Mr. Anuj Guleria, PhD student of the Department of Botany was held on 22-05-2025 at 3:00 pm in the office of the Head, Department via blended mode (Google Meet). The following members were present:


Dr. Yogesh Kumar	Associate Professor and Head, Dept. of Botany, CUJ.	HoD and Chairperson
Prof. Namrata Sharma	Professor, Dept. of Botany, Univ. of Jammu	External Expert Member
Dr. Samantha Vaishnavi	Assistant Prof., Dept. of Botany, CUJ	Member
Dr. Vikas Srivastava	Assistant Prof., Dept. of Botany, CUJ	Supervisor and Convener

2. The meeting began with a formal welcome note by the Chair.
3. The following points were noted by the RAC members.
- 3.1. The progress of Ph.D. work of Mr. Anuj Guleria was satisfactory and substantial.
- 3.2. Prof. Namrata Sharma has advised to present his work in seminar/conferences and also to communicate a review article from the PhD work.
- 3.3. Dr. Yogesh Kumar has suggested for ensuring the data must have sufficient replicates.


22/05/2025
Dr. Yogesh Kumar
Head, Dept. of Botany, CUJ
(HoD and Chairperson)


Prof. Namrata Sharma
Dept. of Botany
University of Jammu
(Subject Expert Member)


Dr. Samantha Vaishnavi
Assistant Prof., Dept. of
Botany, CUJ
(Member)


22/05/25
Dr. Vikas Srivastava
Assistant Professor Dept. of
Botany, CUJ
(Supervisor and Convener)





Central University of Jammu, Jammu
Research Advisory Committee
Department of Botany
School of Life Sciences
PhD Progress Report

RAC Recommendation:

Name of the Scholar	Anuj Guleria		
Name of the Supervisor	Dr. Vikas Srivastava		
Title of Ph.D. thesis	Screening and characterization of rhizobacteria from the fields of <i>Solanum tuberosum</i> L. for plant growth promoting and biocontrol activities.		
Department	Botany		
Name, Designation, Address of DRC/RAC members			
1	Dr. Yogesh Kumar, Associate Professor and Head, Dept. of Botany, CUJ	HoD and Chairperson	
2	Prof. Namrata Sharma, Professor, Dept. of Botany, Univ. of Jammu	External Expert Member	
3	Dr. Samantha Vaishnavi, Assistant Prof., Dept. of Botany, CUJ	Member	
4	Dr. Vikas Srivastava, Assistant Prof., Dept. of Botany, CUJ	Supervisor and Convener	
Duration of Progress	December, 2024- May, 2025		
Approximate %age of Research Work completed	45%		
	✓ Good	✗ Average	✗ Satisfactory
			✗ Not Satisfactory
Remarks if Any:			

Signature of RAC Members:

Dr. Yogesh Kumar
 Head, Dept. of Botany, CUJ
 (HoD and Chairperson)

22/05/2025

Prof. Namrata Sharma
 Dept. of Botany
 University of Jammu
 (Subject Expert Member)

Dr. Samantha Vaishnavi
 Assistant Prof., Dept. of Botany,
 CUJ
 (Member)

Dr. Vikas Srivastava
 Assistant Professor Dept. of
 Botany, CUJ
 (Supervisor and Convener)

Minutes of the Meeting of Research Advisory Committee

1. A meeting of the Research Advisory Committee (RAC) for Ms. Akshu Jasrotia, a Ph.D. student in the Department of Botany, was held on 30-05-2025 at 10:45 am in the office of the Head of Department via blended mode (Google Meet). The following members attended the meeting:

Dr. Yogesh Kumar	Associate Professor and Head, Dept. of Botany, CUJ (Supervisor)	Chairperson and HOD
Prof. Susheel Verma	Professor, Department of Botany, University of Jammu, Jammu	Subject Expert
Dr. Samantha Vaishnavi	Assistant Professor, Dept. of Botany, CUJ	Member

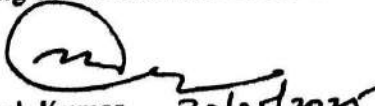
2. The meeting began with a formal welcome by the Chairperson.
 3. Ms. Akshu informed the committee members that she has successfully completed her Ph.D. coursework, with the following courses:


Course Code	Course Title	Credit	Mode
ini24-ge06	Fundamentals of Research (Major)	4	MOOC
nou24-ge73	Research and Publication Ethics (RPE)	2	MOOC
PBOT10001T	Techniques in Biological Research	2	Offline
PBOT10007T	Advanced Plant Virology	4	Offline
PBOT10008T	Perspectives in Plant Diversity	4	Offline
Total Credits:		16	

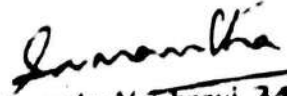
4. Ms. Akshu presented her Ph.D. synopsis, which included her plan of work, research title, and objectives. The thesis title, objectives, and methodology were thoroughly discussed, and the following title was finalised for further recommendation by the Board of Studies:

Title: Unravelling the begomovirus diversity and pathogenesis mechanisms in yellow vein mosaic-affected *Abelmoschus esculentus* (L.) Moench. in Jammu region

5. The committee found the preliminary work done by Ms. Akshu to be satisfactory.
 6. The meeting concluded with a vote of thanks by the chairperson.


 Dr. Yogesh Kumar 30/05/2025
 Associate Professor and Head,
 Dept. of Botany, CUJ
 (Supervisor and Chairperson)


 Prof. Susheel Verma
 Professor, Uni. of Jammu
 (Subject Expert)


 Dr. Samantha Vaishnavi 30/5/2025
 Assistant Professor,
 Dept. of Botany, CUJ.
 (Member)

Minutes of the Meeting of Research Advisory Committee

1. A meeting of the Research Advisory Committee (RAC) for Ms. Chahat Slathia, a Ph.D. student in the Department of Botany, was held on 27th May, 2025 at 3:00 pm in the office of the Head of Department in blended mode (Google Meet). The following members attended the meeting:

Dr. Yogesh Kumar	Associate Professor and Head, Department of Botany, Central University of Jammu	Chairperson and HOD (Supervisor)
Prof. Brajeshwar Singh	Professor, Division of Microbiology, Faculty of Basic Sciences, SKUAST, Jammu	Subject Expert
Prof. B.S. Bhau	Professor, Department of Botany, Central University of Jammu	Member

2. The meeting began with a formal welcome by the Chairperson.
 3. In the beginning, Ms. Chahat informed the committee members that she has successfully completed her Ph.D. coursework, as detailed below:

Course Code	Course Title	Credit	Mode
ini24-ge06	Fundamentals of Research (Major)	4	MOOC
nou24-ge73	Research and Publication Ethics (RPE)	2	MOOC
PBOT10001T	Techniques in Biological Research	2	Offline
PBOT10007T	Advanced Plant Virology	4	Offline
PBOT10008T	Perspectives in Plant Diversity	4	Offline
Total Credits:		16	

4. Ms. Chahat Slathia presented her Ph.D. synopsis, which included her plan of work, research title and objectives. The thesis title, objectives, and methodology were thoroughly discussed, and the following title was finalised for further recommendation by the Board of Studies:
Title: Molecular characterization of the virus(es) causing yellow mosaic disease of *Phaseolus vulgaris* in Jammu, development of diagnostic tools, and resistance screening
5. Prof. Brajeshwar advised Ms. Chahat to concentrate on the Poonch and Baderwah districts of Jammu for sample collection as part of this research work.
 6. Prof. B.S. Bhau advised Ms. Chahat to start collecting the germplasm of *P. vulgaris* from different sources.
 7. The committee found the preliminary work done by Ms. Chahat Slathia to be satisfactory.
 8. The meeting concluded with a vote of thanks by the Chairperson.

Dr. Yogesh Kumar 27/05/25
 (Supervisor and Chairperson)

Prof. Brajeshwar Singh 27/5/25
 (Subject Expert)

Prof. B.S. Bhau 27/05/25
 (Member)


Reson

Minutes of the Meeting of Research Advisory Committee


A meeting of the Research Advisory Committee (RAC) for Ms. Shreya Proach (0451719), a Ph.D. student in the Department of Botany, was held on 26-05-2025 in the office of the Head of Department in blended mode (Google Meet). The following members attended the meeting:


Dr. Yogesh Kumar	Associate Professor and Head, Dept. of Botany	Chairman
Prof. B. S. Bhau	Head, Dept. of Botany, CUJ	Supervisor
Dr. Sumit Gandhi	Principal Scientist, CSIR-IIIM, Jammu	External Expert
Dr. Samantha Vaishnavi	Assistant Professor, Dept. of Botany, CUJ	Member

1. The progress of Ph.D. work of Ms. Shreya Proach was found to be satisfactory by RAC members.
2. Dr. Sumit Gandhi, CSIR-IIIM emphasised about the publications.
3. The meeting concluded with a vote of thanks by the Chairperson.

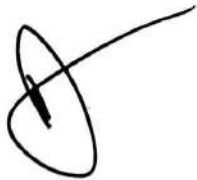

26/5/25
Prof. B.S. Bhau
Professor, Dept. of Botany, CUJ
(Supervisor)


26/5/25
Dr. Samantha Vaishnavi
(Member)


26/May/2025
Dr. Sumit Gandhi
Senior Principal Scientist,
CSIR-IIIM, Jammu (Subject
Expert)


02/06/2025
Dr. Yogesh Kumar
Associate Professor and
Head, Dept. of Botany, CUJ
(Chairman)













Central University of Jammu, Jammu

Departmental Research Committee / Research Advisory Committee

Department of Botany
School of Life Sciences

PhD Progress Report

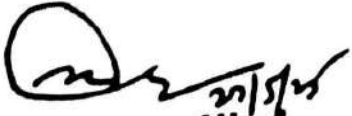
DRC/RAC Recommendation:

Name of the Scholar	Shreya Proch
Name of the Supervisor	Prof BS Bhau
Title of Ph D thesis	Ameliorative effects of PGPR (Plant Growth Promoting Rhizobia) under water deficit conditions and their molecular insights using modelling and docking in the common bean (<i>Phaseolus vulgaris</i> L.)
Department/Centre	Botany
Name, Designation, Address of DRC/RAC members	
1 Dr. Yogesh Kumar- HOD, Dept. of Botany- Chairman	
2 Prof. BS Bhau,- Supervisor	
2 Dr. Sumit Gandhi, Scientist- F & Head, Infectious Diseases Div., CSIR-IIIM- External Expert	
3 Dr. Samantha Vaishnavi, Assistant Prof., Dept. of Botany - Member	
Duration of Progress	JAN 2025- MAY 2025
Approximate %age of Research Work completed	90 %
Good <input type="checkbox"/>	Average <input type="checkbox"/>
Satisfactory <input checked="" type="checkbox"/>	Not Satisfactory <input type="checkbox"/>
Remarks if Any:	
<ul style="list-style-type: none"> All RAC members were satisfied with her progress and suggested the early completion of her Ph.D. work, while also advising her to communicate her research findings for publication 	

Signature of DRC/RAC Members

1.  2. Dr. Sumit Gandhi

3. Dr. Samantha Vaishnavi  27/5/25

 27/5/25
Name & Signature of Head
(Yogesh Kumar)

Name & Signature of Dean

Minutes of the Meeting of Research Advisory Committee

1. The meeting of Research Advisory Committee (RAC) for Ms. Diksha Bagal, PhD student of the Department of Botany was held on 26-05-2025 at 2:30 pm in the office of the Head of Department via blended mode (Google Meet). The following members were present:


Dr. Yogesh Kumar	Associate Professor and Head, Dept. of Botany, CUJ	HoD and Chairperson
Dr. Sumit G. Gandhi	Principal Scientist, CSIR-IIIM, Jammu	External Expert Member
Dr. Deepak Bhardwaj	Associate Prof., Dept. of Botany, CUJ	Member
Dr. Vikas Srivastava	Assistant Prof., Dept. of Botany, CUJ	Supervisor and Convener


2. The meeting began with a formal welcome note by the Chair.


3. The following points were noted by the RAC members.

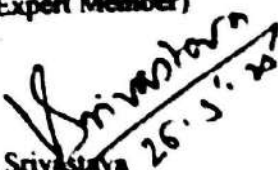
3.1. The Research work presented by Ms. Diksha Bagal was found to be satisfactory by all RAC members.

3.2. The committee has appreciated her publications (one each of research article and review article) and awards in National and International conferences, where she has presented her work derived from her PhD thesis.


26/05/2025
Dr. Yogesh Kumar
Head, Dept. of Botany, CUJ
(HoD and Chairperson)


26/may/2025
Dr. Sumit Gandhi
Principal Scientist
CSIR-IIIM, Jammu
(External Expert Member)


Dr. Deepak Bhardwaj
Associate Prof., Dept. of
Botany, CUJ
(Member)


26.5.25
Dr. Vikas Srivastava
Assistant Professor Dept. of
Botany, CUJ
(Supervisor and Convener)

NSM









Central University of Jammu, Jammu
Research Advisory Committee
Department of Botany
School of Life Sciences
PhD Progress Report

RAC Recommendation:

Name of the Scholar		Diksha Bagal	
Name of the Supervisor		Dr. Vikas Srivastava	
Title of Ph.D. thesis		Studies on the contribution of melatonin and hydrogen sulphide during water stress in <i>Solanum lycopersicum</i> L.	
Department		Botany	
Name, Designation, Address of DRC/RAC members			
1	Dr. Yogesh Kumar, Associate Professor and Head, Dept. of Botany, CUJ	HoD and Chairperson	
2	Dr. Sumit G. Gandhi, Principal Scientist, CSIR-IIIM, Jammu	External Expert Member	
3	Dr. Deepak Bhardwaj, Associate Prof., Dept. of Botany, CUJ	Member	
4	Dr. Vikas Srivastava, Assistant Prof., Dept. of Botany, CUJ	Supervisor and Convener	
Duration of Progress		December, 2024- May, 2025	
Approximate %age of Research Work completed		70%	
<input checked="" type="checkbox"/> Good <input checked="" type="checkbox"/> Average <input checked="" type="checkbox"/> Satisfactory <input checked="" type="checkbox"/> Not Satisfactory			
Remarks if Any:			

Signature of RAC Members:

Dr. Yogesh Kumar
 Head, Dept. of Botany, CUJ
 (HoD and Chairperson)

26/05/2025

Dr. Sumit G. Gandhi
 Principal Scientist
 CSIR-IIIM, Jammu
 (External Expert Member)

26/05/2025

Dr. Deepak Bhardwaj
 Associate Prof., Dept. of Botany,
 CUJ
 (Member)

Dr. Vikas Srivastava
 Assistant Professor Dept. of
 Botany, CUJ
 (Supervisor and Convener)

26.05.25

Minutes of the Meeting of Research Advisory Committee

1. A meeting of the Research Advisory Committee (RAC) for Ms. Isha Kumari, a Ph.D. student in the Department of Botany, was held on 30-05-2025 at 11:00 AM in the office of the Head of Department via blended mode (Google Meet). The following members attended the meeting:

Dr. Yogesh Kumar	Associate Professor and Head, Dept. of Botany, CUJ	Chairperson and HoD
Prof. Susheel Verma	Professor, Department of Botany, University of Jammu, J&k	Subject Expert
Dr. Vikas Srivastava	Assistant Professor Department of Botany, CUJ	Member
Dr. Ashok Kumar	Assistant Professor Department of Botany, CUJ	Ph.D. Supervisor

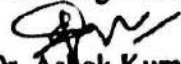
2. The meeting began with a formal welcome by the Chairperson.
3. Ms. Isha Kumari informed the committee members that she has successfully completed her Ph.D. coursework, with the following courses:


Course Code	Course Title	Credit	Mode
ini24-ge06	Fundamentals of Research (Major)	4	MOOC
nou24-ge73	Research and Publication Ethics (RPE)	2	MOOC
PBOT1C001T	Techniques in Biological Research	2	Offline
PBOT1O007T	Advanced Plant Virology	4	Offline
PBOT1O008T	Perspectives in Plant Diversity	4	Offline
Total Credits:		16	

4. Ms. Isha Kumari presented her Ph.D. synopsis, including research title, objectives and plan of work. The thesis title, objectives, and methodology were thoroughly discussed, and the following title was finalised for further recommendation by the Board of Studies:

Title: "Exploration of wild relatives of millets from Jammu region for their nutritional profiling and germplasm conservation"

5. The committee found the preliminary work done by Ms. Isha Kumari to be satisfactory.
6. The meeting concluded with a vote of thanks by the chair.


Dr. Ashok Kumar
Assistant Professor,
Dept. of Botany, CUJ
(Supervisor)


Prof. Susheel Verma
Professor, Department of
Botany, University of
Jammu, J&K
(Subject Expert)

Dr. Yogesh Kumar
Associate Professor, Dept. of
Botany, CUJ
(Chairperson and HoD)

Dr. Vikas Srivastava
Assistant Professor
Dept. of Botany, CUJ
(Member)

Minutes of the Meeting of the Research Advisory Committee

Department of Botany
Central University of Jammu



Venue: Office of Head, Department of Botany, CUJ, Bagla

Date: Monday, 02nd June, 2025

Time: 9:00 am

NSH


Page 1 of 2

Minutes of the Meeting of Research Advisory Committee

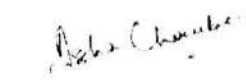
1. The meeting of Research Advisory Committee for Ms. Jyoti Priya Samantaray, Research Scholar Department of Botany was held on 02-06-2025 at 9:00 am in the Office of the Head of Department via blended mode (Google Meet) to review the progress. The following members were present

Dr. Yogesh Kumar	Associate Professor and Head, Dept. of Botany, CUJ	Chairman
Dr. Asha Chaubey	Principal Scientist & Head, Fermentation Technology Division, CSIR-Indian Institute of Integrative Medicine, Jammu	External Expert
Dr. Deepak Bhardwaj	Associate Professor, Department of Botany, CUJ	Member, Supervisor
Dr. Samantha Vaishnavi	Assistant Professor, Department of Botany, CUJ	Member

2. The meeting began with a formal welcome note by the Chair.
3. Ms. Jyoti Priya Samantaray presented the work done by her during the past six months.
4. The RAC members recommended a revision of the thesis title for Ms. Jyoti Priya Samantaray. The revised title is: **"Harnessing Arbuscular Mycorrhizal Fungi for Trait Enhancement in *Justicia adhatoda* L., *Pisum sativum* L., and *Oryza sativa* L."** The committee also acknowledged that Ms. Samantaray's overall research progress has been satisfactory.
5. The meeting concluded with vote of thanks to the external expert and other members.

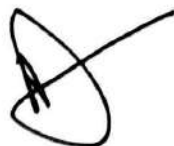

Dr. D. Bhardwaj

Dr. S. Vaishnavi
(online)


Dr. Asha Chaubey
(online)


Dr. Yogesh Kumar













Central University of Jammu, Jammu

Departmental Research Committee / Research Advisory Committee

Department of Botany

School of Life Sciences

Ph.D. Progress Report

DRC/RAC Recommendation:

Name of the Scholar	Ms. Jyoti Priya Samantaray
Name of the Supervisor	Dr. Deepak Bhardwaj
Title of Ph.D. thesis	Biodiversity of Arbuscular Mycorrhizal Fungi in medicinally important <i>Justicia adathoda</i> of Jammu and its effects on the level of Vasicine and Vasicinone.
Department/Centre	Botany
Name, Designation, Address of RAC members	
1. Dr. Yogesh Kumar, Associate Professor and Head, Department of Botany, CUJ	
2. Dr. Asha Chaubey, Principal Scientist & Head, Fermentation Technology Division, CSIR-Indian Institute of Integrative Medicine, Jammu (External expert)	
3. Dr. Deepak Bhardwaj, Associate Professor, Dept. of Botany, CUJ (Supervisor)	
4. Dr. Samantha Vaishnavi, Assistant Professor, Department of Botany, CUJ (Member)	
Duration of Progress	January 2025 – May 2025
Approximate %age of Research Work completed	95%
<input checked="" type="checkbox"/> Good <input type="checkbox"/> Average <input type="checkbox"/> Satisfactory <input type="checkbox"/> Not Satisfactory	
Remarks, if Any:	
Ms. Jyoti Priya Samantaray's overall work progress is found to be Good.	

Signature of RAC Members

1. Dr. D. Bhardwaj

2. Dr. S. Vaishnavi
(online)

3. Dr. Yogesh Kumar

4. Dr. A. Chaubey
(online)

Name & Signature of Head

Name & Signature of Dean

Yogesh Kumar <yogesh.bot@cuajammu.ac.in>

Fwd: RAC minutes-Jyoti Priya Samantaray

Mon, Jul 28, 2025 at 11:54 AM

Deepak Bhardwaj <dbhardwajpmb@gmail.com>
To: Yogesh Kumar <yogesh.bot@cuajammu.ac.in>

----- Forwarded message -----

From: ASHA CHAUBEY <achaubey.ilm@csir.res.in>
Date: Tue, Jun 3, 2025 at 3:39 PM
Subject: Re: RAC minutes-Jyoti Priya Samantaray
To: <dbhardwajpmb@gmail.com>

Dear Dr Bhardwaj,
PFA the signed documents.
best wishes.
Asha Chaubey

From: dbhardwajpmb@gmail.com
To: "ASHA CHAUBEY" <achaubey@iiim.res.in>
Sent: Tuesday, June 3, 2025 12:17:07 PM
Subject: Re: RAC minutes-Jyoti Priya Samantaray

Dear Ma'am,
Once again thanks for your continued support for your invaluable help.
Please find attached the documents for your reference. Kindly, endorse them with your signature.

Warm regards,
Deepak

On Fri, Jan 31, 2025 at 12:20 PM ASHA CHAUBEY <achaubey@iiim.res.in> wrote:
Dear Dr Deepak Bhardwaj,
PFA the desired documents.
with regards,
Asha Chaubey

From: dbhardwajpmb@gmail.com
To: "ASHA CHAUBEY" <achaubey@iiim.res.in>
Sent: Friday, January 31, 2025 10:27:19 AM
Subject: Re: RAC minutes-Jyoti Priya Samantaray

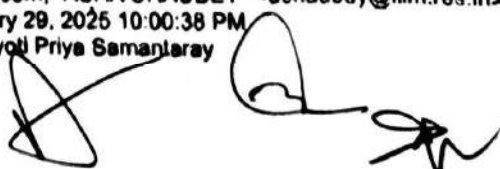
Thanks, I received it.
Kindly send the signed copies of the progress report and remuneration form as well. Apologies for any inconvenience.

Warm regards,
Deepak

On Fri, Jan 31, 2025 at 9:53 AM ASHA CHAUBEY <achaubey@iiim.res.in> wrote:
Dear Dr Deepak,
PFA the signed minutes.
regards,

From: dbhardwajpmb@gmail.com
To: ashchaubey@gmail.com, "ASHA CHAUBEY" <achaubey@iiim.res.in>
Sent: Wednesday, January 29, 2025 10:00:38 PM
Subject: RAC minutes-Jyoti Priya Samantaray

ns sh



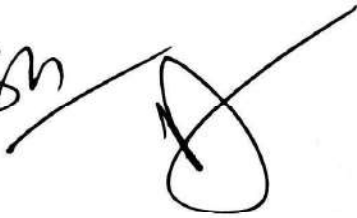
Dear Ma'am
I hope you are doing well.

As per our discussion, please find attached the documents for Ms. Jyoti Priya Samantaray's RAC meeting held on December 19, 2024. Kindly provide your electronic signature. Let me know if you require any additional information.

Warm regards,
Deepak

 attachments (2).zip
596K

h38m





hod bot <hod.bot@cuajammu.ac.in>

Fwd: RAC documents

Deepak Bhardwaj <dbhardwajpmb@gmail.com>
To: hod bot <hod.bot@cuajammu.ac.in>

Thu, Jun 12, 2025 at 12:48 PM

----- Forwarded message -----

From: S V <samantha.bot@cuajammu.ac.in>
Date: Thu, 12 Jun 2025, 02:54
Subject: Re: RAC documents
To: Deepak Bhardwaj <dbhardwajpmb@gmail.com>

Dear Dr. Bhardwaj

Please consider this Email as approval for the minutes of the meeting of the RAC and Ms. Jyotipriya Samantray's progress report as attached in the trail mail.

Regards,

Samantha

On Wed, Jun 11, 2025 at 7:20 PM Deepak Bhardwaj <dbhardwajpmb@gmail.com> wrote:
Dear Ma'am,

As discussed, please add your digital signature on the attached documents. If necessary, feel free to make any corrections you deem appropriate.

Regards,
Deepak

Minutes of the Meeting
Research Advisory Committee
of
Department of Botany
Central University of Jammu
For
Ms. Barkha Parihar (Roll No. 0151719)



Venue: Department of Botany, CUJ (Online mode)
Date: June 11, 2025

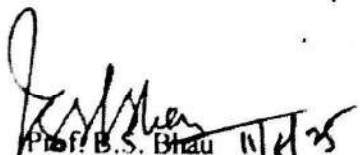
[Handwritten signatures and initials]

Minutes of the Meeting of Research Advisory Committee


A meeting of the Research Advisory Committee (RAC) for Ms. Barkha Parihar (0151719), a Ph.D. student in the Department of Botany, was held on 11-06-2025 at 2:00PM in online mode (Google Meet). The following members attended the meeting:


Dr. Yogesh Kumar	Associate Professor and Head, Dept. of Botany	Chairperson
Prof. B. S. Bhau	Professor, Dept. of Botany, CUJ	Supervisor
Dr. Sumit Gandhi	Principal Scientist, CSIR-IIIM, Jammu	External Expert
Dr. Samantha Vaishnavi	Assistant Professor, Dept. of Botany, CUJ	Member

1. The Research Advisory Committee (RAC) found the progress of Ms. Barkha Parihar's Ph.D. work to be satisfactory.
2. Dr. Sumit Gandhi (CSIR-IIIM), Subject expert and Dr. Yogesh, Chairperson of the RAC & HOD, highlighted the importance of research publications and encouraged timely dissemination of research findings.
3. The meeting concluded with a formal vote of thanks extended by the Chairperson.

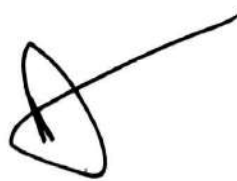

Prof. B.S. Bhau 11/6/25
Professor, Dept. of Botany, CUJ
(Supervisor)

Dr. Samantha Vaishnavi
(Member)
(online)


Dr. Sumit Gandhi
Senior Principal Scientist,
CSIR-IIIM, Jammu (Subject
Expert)


Dr. Yogesh Kumar
Associate Professor and
Head, Dept. of Botany, CUJ
(Chairman)

RSB











Central University of Jammu, Jammu

Departmental Research Committee / Research Advisory Committee

Department of Botany
School of Life Sciences

PhD Progress Report

DRC/RAC Recommendation:

Name of the Scholar	Barkha Parihar
Name of the Supervisor	Prof. BS Bhau
Title of Ph.D. thesis	Biological control of anthracnose on <i>P. vulgaris</i> L. using <i>Trichoderma</i> spp. aided with protein ligand docking using in silico methods
Department/Centre	Botany
Name, Designation, Address of DRC/RAC members	
1. Dr. Yogesh Kumar- HOD, Dept. of Botany- Chairman	
2. Prof. BS Bhau,- Supervisor	
2. Dr. Sumit Gandhi, Scientist- F & Head, Infectious Diseases Div., CSIR-IIIM- External Expert	
3. Dr. Samantha Vaishnavi, Assistant Prof., Dept. of Botany - Member	
Duration of Progress	JAN 2025- MAY 2025
Approximate %age of Research Work completed	90 %
Good <input checked="" type="checkbox"/> Average <input type="checkbox"/> Satisfactory <input type="checkbox"/> Not Satisfactory <input type="checkbox"/>	
Remarks if Any:	
<ul style="list-style-type: none"> All RAC members were satisfied with her progress and suggested the early completion of her Ph.D. work, while also advising her to communicate her research findings for publication 	

Signature of DRC/RAC Members

1. Prof. BS Bhau

2. Dr. Sumit Gandhi

3. Dr. Samantha Vaishnavi
(online)

Name & Signature of Head
(Dr. Yogesh Kumar)

Name & Signature of Dean



hod bot <hod.bot@cuajammu.ac.in>

Approval of Minutes and Progress Report – RAC Meeting of Ms. Barkha Parihar (Held on June 11, 2025)

3 messages

hod bot <hod.bot@cuajammu.ac.in>

Thu, Jun 12, 2025 at 10:48 AM

To: Sumit Gandhi <sumit@iim.res.in>, Sumit Gandhi <drosophilist@gmail.com>, bs bhau <bsbhau@cuajammu.ac.in>, S V <samantha.bot@cuajammu.ac.in>

Dear RAC Members,

With reference to the RAC meeting of Ms. Barkha Parihar held on June 11, 2025, at 2:00 PM, you are kindly requested to review and provide your approval for the attached minutes of the meeting and the scholar's progress report.

The key points discussed and recorded are as follows:

1. The Research Advisory Committee (RAC) found the progress of Ms. Barkha Parihar's Ph.D. work to be satisfactory.
2. Dr. Sumit Gandhi (CSIR-IIIM), Subject Expert, and Dr. Yogesh, Chairperson of the RAC and Head of the Department, emphasized the importance of research publications and encouraged the timely dissemination of research findings.
3. The progress made by Ms. Barkha Parihar is approximately 90%.

Kindly provide your approval at the earliest convenience.

Warm regards,

Yogesh Kumar, PhD
Associate Professor & Head
Department of Botany
Central University of Jammu
Jammu and Kashmir, India
Postal Code: 181143
Mob: 7696180390
Email: yogesh.bot@cuajammu.ac.in; hod.bot@cuajammu.ac.in

2 attachments

BP May 2025 Minutes RAC .doc
125K

JAN MAY 2025 Barkha PROGRESS REPORT - DRC .docx
99K

Sumit Gandhi <sumitgandhi.iim@csir.res.in>

Thu, Jun 12, 2025 at 11:23 AM

To: hod bot <hod.bot@cuajammu.ac.in>

Cc: drosophilist@gmail.com, bsbhau@cuajammu.ac.in, samantha bot <samantha.bot@cuajammu.ac.in>

Dear Sir,
Greetings!

Please find attached the signed proceedings. Please let me know if anything else needs to be done from my end.

Regards,
Sumit

From: "hod bot" <hod.bot@cuajammu.ac.in>

To: "Sumit Gandhi" <sumit@iim.res.in>, drosophilist@gmail.com, bsbhau@cuajammu.ac.in, "samantha bot"


<samantha.bot@cujammu.ac.in>

Sent: Thursday, June 12, 2025 10:48:42 AM

Subject: Approval of Minutes and Progress Report - RAC Meeting of Ms. Barkha Panhar (Held on June 11, 2025)

[Quoted text hidden]

2 attachments

 BP May 2025 Minutes RAC .pdf
576K

 JAN MAY 2025 Barkha PROGRESS REPORT - DRC .pdf
589K

S V <samantha.bot@cujammu.ac.in>

Thu, Jun 12, 2025 at 12:20 PM

To: hod.bot <hod.bot@cujammu.ac.in>

Cc: Sumit Gandhi <sumit@iiim.res.in>, Sumit Gandhi <drosophilist@gmail.com>, bs bhau <bsbhau@cujammu.ac.in>

Dear Dr. Yogesh

Please consider this Email as approval for the minutes of the meeting and Ms. Barkha's progress report as attached in the trail mail.

Regards,

[Quoted text hidden]











Certificate Course in 'Plant Tissue Culture' (6 Months)

Preamble:

The certificate course in 'Plant Tissue Culture' is designed to bridge theoretical knowledge with practical expertise in the rapidly advancing field of plant biotechnology. Rooted in the fundamental principles of totipotency and cellular differentiation, plant tissue culture provides transformative applications in agriculture, horticulture, forestry, conservation, and the pharmaceutical industry. This course provides a comprehensive framework—from historical evolution to cutting-edge innovations—empowering learners with the skills necessary for the research, commercialisation, and sustainable production of high-quality plant materials.

Course Objectives:

Upon completion of this course, students will:

1. Understand the theoretical foundations and historical development of plant tissue culture.
2. Acquire hands-on proficiency in fundamental and advanced tissue culture techniques, including micropropagation, somatic embryogenesis, and genetic transformation.
3. Gain experience in designing, executing, and troubleshooting plant tissue culture protocols for commercial, conservation, and research applications.
4. Develop the ability to assess quality, genetic stability, and acclimatisation efficiency in in vitro propagated plants.
5. Explore entrepreneurship opportunities, industry standards, and regulatory frameworks relevant to plant tissue culture ventures.

Course Structure:

S. No.	Course Name	L-T-P	Credits
1.	Principles and Foundations of Plant Tissue Culture	4-0-0	4
2.	Culture Techniques in Plant Tissue Culture	4-0-0	4
3.	Micropropagation and Hardening Techniques	4-0-0	4
4.	Advanced Methods in Plant Tissue Culture	4-0-0	4
5.	Plant Haploids and Transformation Techniques (Lab)	0-0-4	2
6.	Applied Techniques in Plant Micropropagation and Hardening (Lab)	0-0-4	2
Total			20

Note: The student may opt for any one of the theory courses (S. No. 1 to 4) through MOOCs, provided it is equivalent to the corresponding offline course and approved by the Department.

NS 801



Principles and Foundations of Plant Tissue Culture

LTP: 4-0-0

Credits: 4

Course Objective:

To introduce students to the theoretical and historical foundations of plant tissue culture and the essential laboratory practices that support this field.

Course Outcomes:

Upon successful completion of this course, students will be able to:

1. Explain the historical development and core principles of plant tissue culture, including totipotency and types of culture systems.
2. Design and manage a sterile laboratory environment and understand membrane transport mechanisms in plant cells.
3. Prepare, modify, and sterilise plant tissue culture media tailored to species-specific developmental needs.
4. Apply biosafety standards, contamination control measures, and quality assurance protocols in tissue culture labs.
5. Assess genetic stability and fidelity using molecular tools and interpret results for research and commercial applications.

Syllabus

Unit 1: Historical and Conceptual Foundations

Origin of plant tissue culture; Haberlandt's hypothesis; early developments; contributions by White, Skoog, and Miller; concepts of totipotency, dedifferentiation, redifferentiation, polarity; types of culture systems including organ culture, meristem culture, callus culture, and suspension culture.

Unit 2: Laboratory Infrastructure

Laboratory layout and sterile work design; essential equipment: laminar airflow cabinet, autoclave, incubator, pH meter; lab safety norms, waste disposal practices, documentation protocols; AI-driven inventory and lab management.

Unit 3: Media Composition and Preparation

Macronutrients, micronutrients, vitamins, carbon sources; role and types of gelling agents including agar; auxins and cytokinins in morphogenesis; media preparation and sterilisation techniques: autoclaving, membrane filtration; overview and comparison of MS, WPM, and B5 media; tailoring media to species-specific and stage-specific requirements.

Unit 4: Quality Control and Laboratory Biosafety

Types of contamination: microbial, endogenous; contamination control and sterility testing methods; explant sterilisation protocols; biosafety and ethical considerations; intellectual property rights (IPR); genetic fidelity assessment using ELISA and PCR; management of somaclonal variation; production of disease-free, genetically stable plants.

Unit 5: Molecular Assessment and Commercial Relevance

Molecular tools for genetic assessment: ELISA, PCR; evaluation of phenotypic and genotypic stability; avoidance of somaclonal variation; quality assurance in in-vitro plant



production; applications in horticulture, conservation, and research; regulatory guidelines and certification; entrepreneurship opportunities and industry collaborations in plant tissue culture.

Suggested Readings

Books

1. Bhojwani, S.S., & Dantu, P.K. (2013). *Plant Tissue Culture: An Introductory Text*. Springer.
2. De, K.K. (2019). *Introduction to Plant Tissue Culture 3Ed (Pb 2019)*. OXFORD & IBH PUBLISHING.
3. Sharma, V., & Alam, A. (2015). *Plant Tissue Culture*. I K International Publishing House Pvt. Ltd.
4. Bhojwani, S.S., & Razdan, M.K. (1983). *Plants from Test Tubes: An Introduction to Micropropagation*. Springer.
5. Smith, R.H. (2012). *Plant Tissue Culture: Techniques and Experiments*. Academic Press.

Review papers

1. Thorpe, T.A. (2007). History of plant tissue culture. *Molecular Biotechnology*, 37(2), 169–180.
2. Espinosa-Leal, C.A., Puente-Garza, C.A., & García-Lara, S. (2018). In vitro plant tissue culture: means for production of biological active compounds. *Planta*, 248(1), 1–18.
3. Srivastava, M., et al. (2023). Tissue Culture—A Sustainable Approach to Explore Plant Stresses. *Plants (Basel)*, 12(6), 1265.
4. Srivastava, M., et al. (2012). *Plant Tissue Culture: Current Status and Opportunities*. IntechOpen, DOI: 10.5772/50582.
5. Wang, X., et al. (2022). New Insights into Tissue Culture Plant-Regeneration Mechanisms. *Frontiers in Plant Science*, 13, 926752



Culture Techniques in Plant Tissue Culture

LTP: 4-0-0

Credits: 4

Course Objective:

To provide students with practical knowledge of fundamental tissue culture techniques such as callus induction, organogenesis, and somatic embryogenesis.

Course Outcomes:

Upon successful completion of this course, students will be able to:

1. Select suitable explants and induce callus cultures using growth regulators and optimise for metabolite production.
2. Establish and scale up suspension cultures, analyse growth phases, and assess biomass and metabolite yield.
3. Induce and optimise shoot and root organogenesis through hormonal regulation and assess regeneration efficiency.
4. Perform somatic embryogenesis and develop synthetic seeds for clonal propagation and conservation.
5. Evaluate and troubleshoot in vitro cultures using morphological, physiological, and molecular tools.

Syllabus

Unit 1: Principles and Techniques of Callus Culture

Selection and preparation of explants; surface sterilisation protocols; callus induction and maintenance using growth regulators like 2,4-D and TDZ; optimisation of culture conditions including medium composition, temperature, and LED lighting; role of elicitors (e.g., jasmonic acid, salicylic acid) in enhancing secondary metabolite production; applications in micropropagation and phytochemical yield enhancement.

Unit 2: Establishment and Optimisation of Suspension Cultures

Transition from callus to suspension cultures; initiation, establishment, and scale-up in liquid media; batch vs continuous cultures; shaker and aeration systems; monitoring physical parameters (pH, temperature, agitation); optimisation of media components; growth kinetics: PCV, fresh/dry weight, and cell counting; viability assays (e.g., TTC staining); industrial applications in metabolite production.

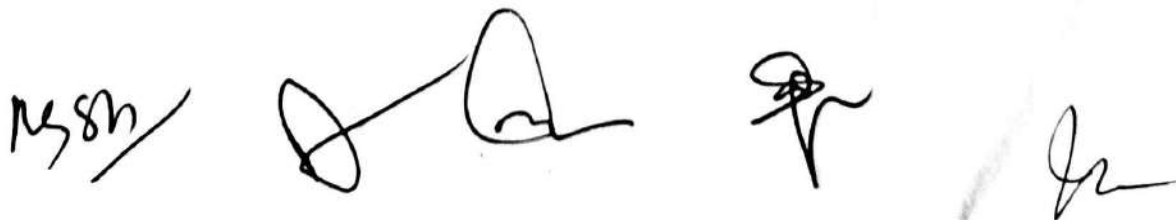
Unit 3: In Vitro Organogenesis

Pathways and phases of shoot and root organogenesis; direct vs. indirect organogenesis; roles of auxins (IAA) and cytokinins (BAP); hormonal ratios and regeneration protocols; molecular regulation via WUSCHEL and ARFs; histological and morphological assessment of regenerated organs; case study: banana (*Musa* spp.) micropropagation.

Unit 4: Somatic Embryogenesis and Synthetic Seed Technology

Phases of somatic embryogenesis: induction, proliferation, maturation; use of 2,4-D and ABA in embryogenic media; comparison with zygotic embryo development; encapsulation techniques using alginate or hydrogel; synthetic seed formation, storage, and germination testing; application in conservation and large-scale propagation; case study: *Pinus* spp.

Unit 5: Culture Evaluation and Application in Plant Biotechnology



Assessment of culture quality through morphological markers and growth analysis; troubleshooting abnormal cultures; introduction to molecular evaluation tools; histology for structural verification; evaluation of somaclonal variation and genetic fidelity; applications in commercial micropropagation, conservation biology, and pharmaceutical production.

Suggested Readings

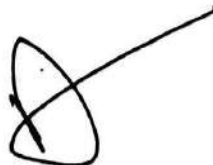

Books

1. Bhojwani, S.S., & Dantu, P.K. (2013). *Plant Tissue Culture: An Introductory Text*. Springer. Covers callus culture, organogenesis, and somatic embryogenesis with practical protocols.
2. De, K.K. (2019). *Introduction to Plant Tissue Culture*. New Central Book Agency. Provides step-by-step guidance on lab techniques, ideal for beginners.
3. Sharma, V., & Alam, A. (2015). *Plant Tissue Culture*. CBS Publishers & Distributors. Includes methods for micropropagation and secondary metabolite production.
4. Brar, D.S., & Khush, G.S. (2006). *Plant Biotechnology and Molecular Markers*. Oxford & IBH Publishing Co. Links tissue culture to plant genetic improvement.
5. Davey, M.R., & Kumar, P. (2011). *In Vitro Plant Breeding*. Alpha Science International. Covers advanced breeding techniques utilizing tissue culture.

Review Papers

1. Huang, X., et al. (2019). Biotechnology Applications of Plant Callus Cultures. *Engineering*, 5(1), 27–31. DOI: 10.1016/j.eng.2018.11.014.
2. Wang, X., et al. (2022). New Insights Into Tissue Culture Plant-Regeneration Mechanisms. *Frontiers in Plant Science*, 13, 926752. DOI: 10.3389/fpls.2022.926752.
3. Fehér, A. (2019). Signaling Overview of Plant Somatic Embryogenesis. *Frontiers in Plant Science*, 10, 77. DOI: 10.3389/fpls.2019.00077.
4. Singh, A.K., et al. (2025). Synthetic Seeds: Innovation in Plant Propagation and Conservation for Sustainable Agriculture. In: *Plant Biotechnology: Principles and Applications*. Springer, pp. 345–367. DOI: 10.1007/978-981-19-4087-9_16.
5. Al-Mazroui, M., et al. (2020). An Academic and Technical Overview on Plant Micropropagation Challenges. *Plants*, 8(8), 677. DOI: 10.3390/plants8080263.
6. Mutegi, H., et al. (2024). A Comprehensive Review of In Planta Stable Transformation Strategies. *Plant Methods*, 20(1), 1–23. DOI: 10.1186/s13007-024-01129-5.

NS 8/21



Micropropagation and Hardening Techniques

LTP: 4-0-0

Credits: 4

Course Objective:

To develop students' expertise in micropropagation protocols and acclimatisation methods for commercially important plant species.

Course Outcomes:

Upon successful completion of this course, students will be able to:

1. Apply stage-wise micropropagation protocols customised for selected commercial and medicinal plants.
2. Establish pathogen-free cultures through indexing, sanitation, and diagnostic assays to ensure optimal growth conditions.
3. Execute effective primary and secondary hardening techniques using optimised substrates and environments.
4. Evaluate plantlet quality and survival using morphological and optional molecular assessment tools.
5. Integrate micropropagation practices with real-time monitoring and environmental optimisation for commercial applications.

Theory

Unit 1: Micropropagation Protocols

Stages I-IV: initiation, multiplication, rooting, and acclimatisation; media modifications for specific species; case studies including saffron, apple, and walnut; use of LED lighting to optimise light spectra for different growth stages; applications in rapid production of uniform plants for agriculture and horticulture.

Unit 2: Pathogen-Free Culture Systems

Culture indexing and in vitro sanitation techniques; explant selection from healthy donor plants; pathogen testing methods such as ELISA, microbial plating, and microscopy; relevance of disease-free material in international trade and disease management.

Unit 3: Primary Hardening of *In Vitro* Plantlets

Environmental parameters critical for primary hardening include humidity, temperature, and light. Substrates used for initial acclimatisation include perlite, peat, and vermiculite. Transfer protocols for plantlets from in vitro to controlled ex-vitro environments are also important.

Unit 4: Secondary Hardening and Environmental Control

Advanced hardening protocols; potting mixtures and final transfer steps; automation and environmental control systems in hardening facilities; strategies to improve plantlet survival and performance during ex vitro adaptation.

Unit 5: Quality and Survival Assessment

Assessment of morphological markers such as shoot number, root length, and vigour; visual inspection and stress response evaluation; optional molecular testing including PCR; use of

NSM


advanced imaging systems for real-time health monitoring; applications in ensuring plantlet quality for commercial viability.

Suggested readings

Books

1. Bhojwani, S.S., & Dantu, P.K. (2013). Plant Tissue Culture: An Introductory Text. Springer.
2. De, K.K. (2019). Introduction to Plant Tissue Culture. New Central Book Agency.
3. Sharma, V., & Alam, A. (2015). Plant Tissue Culture. CBS Publishers & Distributors.
4. Brar, D.S., & Khush, G.S. (2006). Plant Biotechnology and Molecular Markers. Oxford & IBH Publishing Co.
5. Davey, M.R., & Kumar, P. (2011). In Vitro Plant Breeding. Alpha Science International.

Review Papers

1. Srivastava, M., et al. (2023). Tissue Culture—A Sustainable Approach to Explore Plant Stresses. *Plants*, 12(6), 1265. DOI: 10.3390/plants12061265.
2. Huang, X., et al. (2019). Biotechnology Applications of Plant Callus Cultures. *Engineering*, 5(1), 27–31. DOI: 10.1016/j.eng.2018.11.014.
3. Wang, X., et al. (2022). New Insights Into Tissue Culture Plant-Regeneration Mechanisms. *Frontiers in Plant Science*, 13, 926752. DOI: 10.3389/fpls.2022.926752.
4. Fehér, A. (2019). Signaling Overview of Plant Somatic Embryogenesis. *Frontiers in Plant Science*, 10, 77. DOI: 10.3389/fpls.2019.00077.
5. Singh, A.K., et al. (2025). Synthetic Seeds: Innovation in Plant Propagation and Conservation for Sustainable Agriculture. In: *Plant Biotechnology: Principles and Applications*. Springer, pp. 345–367. DOI: 10.1007/978-981-19-4087-9_16.
6. Al-Mazroui, M., et al. (2020). An Academic and Technical Overview on Plant Micropropagation Challenges. *Plants*, 8(8), 677. DOI: 10.3390/plants8080263.
7. Mutegi, H., et al. (2024). A Comprehensive Review of In Planta Stable Transformation Strategies. *Plant Methods*, 20(1), 1–23. DOI: 10.1186/s13007-024-01129-5.

NSM



Advanced Methods in Plant Tissue Culture

LTP: 4-0-0

Credits: 4

Course Objective:

To train students in advanced plant tissue culture techniques, including haploid production, genetic transformation, and the use of bioreactors.

Course Outcomes:

Upon successful completion of this course, students will be able to:

1. Apply androgenic and gynogenic culture methods for haploid plant production.
2. Perform embryo rescue and endosperm culture for developing viable hybrids and triploid plants.
3. Execute Agrobacterium-mediated and direct gene transfer techniques for plant transformation.
4. Operate and optimise bioreactor systems for large-scale tissue culture applications.
5. Analyse transformation success and culture performance using molecular and physiological assessment tools.

Syllabus

Unit 1: Androgenic and Gynogenic Haploid Production

Anther and pollen culture (androgenesis); ovule and ovary culture (gynogenesis); species-specific requirements; culture media and environmental conditions; applications in homozygous line development and crop improvement.

Unit 2: Embryo and Endosperm Culture Techniques

Hybrid embryo rescue; ovule culture and endosperm culture for triploid plant production; critical factors: stage of explant, composition of media, culture conditions; case applications in overcoming interspecific hybridisation barriers.

Unit 3: Plant Genetic Transformation – Agrobacterium Method

Vector systems, promoters, selectable marker genes; Agrobacterium tumefaciens-mediated transformation; co-cultivation protocols; confirmation of transgene integration and expression using PCR, GUS, GFP assays; relevance to crop biotechnology.

Unit 4: Direct Gene Transfer Methods

Biolistics (particle bombardment), PEG-mediated transformation, electroporation; comparison with Agrobacterium-mediated methods; factors influencing transformation; efficiency; regeneration of transformed plants.

Unit 5: Bioreactor-Based Tissue Culture and Optimisation

Types of bioreactors: temporary immersion, airlift, stirred-tank; scale-up strategies; monitoring and control of parameters: pH, temperature, aeration, nutrient flow; smart bioreactors with AI-based systems; case study: Podophyllum metabolite production and other industrial applications.



Suggested readings**Books**

1. Bhojwani, S.S., & Dantu, P.K. (2013). *Plant Tissue Culture: An Introductory Text*. Springer.
2. Sharma, V. (2015). *Plant Tissue Culture*. I K International Publishing House.
3. De, K.K. (2019). *Introduction to Plant Tissue Culture, Third Edition*. Oxford & IBH Publishing.
4. Bhojwani, S.S., & Razdan, M.K. (1996). *Plant Tissue Culture: Theory and Practice*. Oxford & IBH Publishing Co.
5. Razdan, M.K. (2003). *Introduction to Plant Tissue Culture*. Oxford & IBH Publishing Co.

Review Papers

1. Mookkan, M., Nelson, R., & McCabe, C. (2017). Advancing Crop Transformation in the Era of Genome Editing. *The Plant Cell*, 29(5), 716–729. DOI: 10.1105/tpc.16.00948.
2. Mutegi, H., et al. (2024). A comprehensive review of in planta stable transformation strategies. *Plant Methods*, 20(1), 1–23. DOI: 10.1186/s13007-024-01200-8.
3. Sutanto, S., et al. (2022). Genetic transformation via plant tissue culture techniques: Current and future approaches. In *Plant Tissue Culture* (pp. 1–23). Springer. DOI: 10.1016/B978-0-323-90795-8.00001-1.
4. Anjanappa, R.B., & Gruissem, W. (2021). Current progress and challenges in crop genetic transformation. *Journal of Plant Physiology*, 263, 153411. DOI: 10.1016/j.jplph.2021.153411.
5. Ferrer, J.L., & Altabella, T. (2023). The advent of plant cells in bioreactors. *Frontiers in Plant Science*, 14, 1310405. DOI: 10.3389/fpls.2023.1310405.
6. Kasha, K.J., & Maluszynski, M. (2003). Production of doubled haploids in crop plants. *Euphytica*, 133(3), 305–312. DOI: 10.1023/A:1025687728081.
7. Dunwell, J.M. (2010). Haploids in flowering plants: origins and exploitation. *Plant Biotechnology Journal*, 8(4), 377–424. DOI: 10.1111/j.1467-7652.2009.00498.x.

Plant Haploids and Transformation Techniques (Lab)

LTP: 0-0-4

Credits: 2

Course Objective:

To provide students with a strong foundation in advanced in vitro techniques related to haploid induction, embryo rescue, genetic transformation, and synthetic seed development with applications in crop biotechnology and hybrid breeding.

Course Outcomes:

Upon successful completion, students will be able to:

1. Apply androgenic and gynogenic culture methods for haploid production.
2. Conduct embryo rescue and ovule culture for wide hybridization success.
3. Perform Agrobacterium-mediated transformation and understand selection strategies.
4. Develop and germinate synthetic seeds using encapsulation protocols.
5. Analyse genetic transformation and plant quality through physiological and molecular tools.

Practical

1. Lab orientation and identification of instruments.
2. Preparation and sterilization of nutrient media.
3. Aseptic techniques, surface sterilization of explants, and handling in laminar airflow.
4. Demonstration of contamination identification and control.
5. Androgenic haploid induction using anther cultures.
6. Embryo rescue and ovule culture.
7. Agrobacterium co-cultivation with explants.
8. Development and germination of synthetic seeds.
9. ELISA demonstration for disease detection.
10. Interaction with industry/academic mentor and report submission.

Suggested Readings:**Books**

1. Bhojwani, S. S., & Dantu, P. K. (2013). Plant Tissue Culture: An Introductory Text. Springer.
2. Smith, R. H. (2013). Plant Tissue Culture: Techniques and Experiments (3rd ed.). Academic Press.
3. George, E. F., Hall, M. A., & De Klerk, G.-J. (2008). Plant Propagation by Tissue Culture (3rd ed.). Springer.
4. Trigiano, R. N., & Gray, D. J. (2011). Plant Tissue Culture, Development, and Biotechnology. CRC Press.
5. Loyola-Vargas, V. M., & Ochoa-Alejo, N. (Eds.) (2012). Plant Cell Culture Protocols. Humana Press.
6. Bhojwani, S. S., & Razdan, M. K. (1996). Plant Tissue Culture: Theory and Practice. Elsevier.

MSM

A

A

S

J

7. Ferrie, A. M. R., & Möllers, C. (2011). Haploid and Doubled Haploid Techniques in Brassica Species. In *Plant Cell Culture Protocols*, Humana Press.
8. Ochatt, S. J., & Jain, S. M. (2007). *Breeding of Neglected and Under-Utilized Crops, Spices, and Herbs*. Science Publishers.
9. Raghavan, V. (2003). *Developmental Biology of Flowering Plants*. Springer.

Research Papers

1. Lespinasse, Y.Y., & Boudet, J.M. (2008). In vitro androgenesis in tree species: An update and prospect for further research. *Plant Cell, Tissue and Organ Culture*, 94(2), 133–148. DOI: 10.1007/s11240-008-9389-2.
2. Germanà, M.I. (2011). Anther culture for haploid and doubled haploid production. *Plant Cell, Tissue and Organ Culture*, 104(3), 283–300. DOI: 10.1007/s11240-010-9852-x.
3. Sutanto, S., et al. (2022). Genetic transformation via plant tissue culture techniques: Current and future approaches. In *Plant Tissue Culture* (pp. 1–23). Springer. DOI: 10.1016/B978-0-323-90795-8.00001-1.
4. Mutegi, H., et al. (2024). A comprehensive review of in planta stable transformation strategies. *Plant Methods*, 20(1), 1–23. DOI: 10.1186/s13007-024-01200-8.
5. Ferrer, J.L., & Altabella, T. (2023). The advent of plant cells in bioreactors. *Frontiers in Plant Science*, 14, 1310405. DOI: 10.3389/fpls.2023.1310405.
6. Kumar, S., et al. (2023). Bioreactor systems for micropropagation of plants: present scenario and future prospects. *Frontiers in Plant Science*, 14, 1159588. DOI: 10.3389/fpls.2023.1159588.
7. Espinosa-Leal, C.A., Puente-Garza, C.A., & García-Lara, S. (2018). In vitro plant tissue culture: means for production of biological active compounds. *Planta*, 248(1), 1–18. DOI: 10.1007/s00425-018-2910-1.
8. Gelvin, S. B. (2010). Plant proteins involved in Agrobacterium-mediated genetic transformation. *Annual Review of Phytopathology*, 48, 45–68.
9. Hiei, Y., & Komari, T. (2008). Agrobacterium-mediated transformation of rice. *Nature Protocols*, 3(5), 824–834.
10. Saiprasad, G. V. S. (2001). Artificial seeds and their applications. *Resonance*, 6(5), 39–47.
11. Rai, M. K., et al. (2009). The role of abscisic acid in somatic embryogenesis. *Plant Cell Reports*, 28, 965–975.
12. Matthews, R. E. F. (1993). *Diagnosis of Plant Virus Diseases*. CRC Press.
13. Clark, M. F., & Adams, A. N. (1977). Characteristics of the microplate method of enzyme-linked immunosorbent assay for the detection of plant viruses. *Journal of General Virology*, 34(3), 475–483.
14. Cassells, A. C. (1991). Pathogen and contamination management in tissue culture. In *In Vitro Cellular & Developmental Biology – Plant*, 27(2), 91–96.
15. Dunwell, J. M. (2010). Haploids in flowering plants: origins and exploitation. *Plant Biotechnology Journal*, 8(4), 377–424.

MSM






Applied Techniques in Plant Micropropagation and Hardening (Lab)

LTP: 0-0-4

Credits: 2

Course Objective:

To train students in the use of bioreactors for mass propagation, along with practical exposure to shoot multiplication, rooting, hardening, and quality assessment of in vitro-derived plants for commercial and research applications.

Course Outcomes:

Upon successful completion, students will be able to:

1. Operate and evaluate small-scale bioreactor systems for shoot and biomass propagation.
2. Perform nodal culture, rooting, and shoot elongation techniques for key species.
3. Implement acclimatization protocols including primary and secondary hardening.
4. Establish and maintain callus and suspension cultures.
5. Assess plant quality through morphological markers and standardized protocols.

Practical

1. Demonstration of use of mini-bioreactor systems.
2. Micropropagation of saffron or apple using nodal explants.
3. In vitro rooting and shoot elongation.
4. Demonstration of primary hardening in growth chambers (visit).
5. Demonstration of secondary hardening in polyhouses (visit).
6. Plant health monitoring and survival data analysis.
7. Callus induction and subculturing.
8. Establishment of cell suspension cultures.
9. Quality checks: shoot count, root health, uniformity.
10. Interaction with industry/academic mentor and report submission.

Suggested readings

Books

1. Smith, R.H. (2012). *Plant Tissue Culture: Techniques and Experiments*, Third Edition. Academic Press.
2. George, E.F., Hall, M.A., & De Klerk, G.J. (2008). *Plant Propagation by Tissue Culture*. Springer.
3. Loyola-Vargas, V.M., & Ochoa-Alejo, N. (Eds.). (2018). *Plant Cell Culture Protocols*, Fourth Edition. Humana Press.
4. Bhojwani, S.S., & Razdan, M.K. (1996). *Plant Tissue Culture: Theory and Practice*. Oxford & IBH Publishing Co.

13/8/23



5. Jha, T.B., & Ghosh, B. (2016). *Plant Tissue Culture: Basic and Applied*. Platinum Publishers.

Research Papers

1. Lespinasse, Y.Y., & Boudet, J.M. (2008). In vitro androgenesis in tree species: An update and prospect for further research. *Plant Cell, Tissue and Organ Culture*, 94(2), 133–148. DOI: 10.1007/s11240-008-9389-2.
2. Germanà, M.I. (2011). Anther culture for haploid and doubled haploid production. *Plant Cell, Tissue and Organ Culture*, 104(3), 283–300. DOI: 10.1007/s11240-010-9852-x.
3. Sutanto, S., et al. (2022). Genetic transformation via plant tissue culture techniques: Current and future approaches. In *Plant Tissue Culture* (pp. 1–23). Springer. DOI: 10.1016/B978-0-323-90795-8.00001-1.
4. Mutegi, H., et al. (2024). A comprehensive review of in planta stable transformation strategies. *Plant Methods*, 20(1), 1–23. DOI: 10.1186/s13007-024-01200-8.
5. Ferrer, J.L., & Altabella, T. (2023). The advent of plant cells in bioreactors. *Frontiers in Plant Science*, 14, 1310405. DOI: 10.3389/fpls.2023.1310405.
6. Kumar, S., et al. (2023). Bioreactor systems for micropropagation of plants: present scenario and future prospects. *Frontiers in Plant Science*, 14, 1159588. DOI: 10.3389/fpls.2023.1159588.
7. Espinosa-Leal, C.A., Puente-Garza, C.A., & García-Lara, S. (2018). In vitro plant tissue culture: means for production of biological active compounds. *Planta*, 248(1), 1–18. DOI: 10.1007/s00425-018-2910-1.



Course Title: Molecular Mechanisms of PGPR-Plant Interactions**Credits: 4****Course Objectives**

1. To provide an in-depth understanding of the molecular mechanisms underlying Plant Growth-Promoting Rhizobacteria (PGPR)-plant interactions.
2. To explore how PGPR promote plant growth, suppress diseases, and enhance stress tolerance through molecular and biochemical pathways.
3. To examine the latest research in genomics, transcriptomics, and metabolomics applied to PGPR studies.
4. To understand the practical applications of PGPR in sustainable agriculture and their potential challenges.
5. To develop critical thinking and research skills through analysis of current literature and case studies.

Course Outcomes

By the end of the course, students will be able to:

1. Describe the diversity and ecological significance of PGPR in plant-microbe interactions.
2. Explain the molecular and genetic mechanisms by which PGPR interact with plants, including signaling pathways and host specificity.
3. Analyze the role of PGPR in plant growth promotion, disease suppression, and stress tolerance using advanced omics techniques.
4. Design and interpret experiments to study PGPR-plant interactions using molecular biology and bioinformatics tools.
5. Critically evaluate the applications and limitations of PGPR in agricultural practices and propose innovative solutions.

Syllabus**Unit I: Introduction to PGPR and Plant-Microbe Interactions**

- Definition and classification of PGPR (e.g., *Bacillus*, *Pseudomonas*, *Azospirillum*).
- Historical perspective and significance in sustainable agriculture.
- Ecological roles of PGPR in the rhizosphere and their interactions with other microbes.
- Overview of plant-microbe interactions and their impact on plant health.

Unit II: Molecular Mechanisms of PGPR-Plant Recognition and Signaling

- Receptor-ligand interactions: role of root exudates and microbial elicitors.
- Signaling pathways: quorum sensing, two-component systems, and jasmonate/ethylene pathways.
- Host specificity and compatibility in PGPR-plant interactions.
- Molecular basis of induced systemic resistance (ISR) triggered by PGPR.
- Confocal laser scanning microscopy (CLSM), Fluorescence in situ hybridization (FISH), Calcium imaging and electrophysiology to study PGPR strains

Unit III: PGPR Mechanisms for Plant Growth Promotion and Disease Suppression

- Phytohormone production: auxins, gibberellins, cytokinins, and their effects on plant growth.

NSR


- Nutrient solubilization: siderophores for iron acquisition, phosphate solubilization.
- Biocontrol mechanisms: antibiosis (e.g., antibiotics, volatile organic compounds), competition, and ISR.
- Case studies: PGPR controlling diseases in crops like tomato (*Fusarium wilt*), wheat (root rot), and maize (bacterial blight).

Unit IV: Advanced Omics and Genomic Approaches in PGPR Research

- Genomics and transcriptomics: identifying PGPR genes involved in plant interactions.
- Metabolomics and proteomics: analyzing PGPR-derived metabolites and signaling molecules.
- CRISPR-Cas9: engineering PGPR and plants for enhanced interactions.
- Bioinformatics tools: QIIME2, Mothur, and R for PGPR omics data analysis.
- Single-cell omics and spatial transcriptomics for studying PGPR-plant interfaces.

Unit V: Applications, Challenges, and Future Directions

- PGPR as biofertilizers and biocontrol agents in sustainable agriculture.
- Commercialization and field applications: successes and limitations.
- Challenges: consistency, scalability, and environmental impacts of PGPR.
- Emerging trends: synthetic biology, microbiome engineering, and climate-resilient PGPR.
- Ethical, biosafety, and regulatory considerations for PGPR applications.

Recommended Readings

Textbooks

1. Glick, B. R. (2012). *Plant Growth-Promoting Bacteria and Stress Management*. Springer.
2. Lugtenberg, B. (2015). *Principles of Plant-Microbe Interactions: Microbes for Sustainable Agriculture*. Springer.
3. Varma, A., & Chincholkar, S. B. (Eds.). (2017). *Microbial Inoculants in Sustainable Agricultural Productivity*. Springer.


Review Articles

1. Glick, B. R. (2012). Plant growth-promoting bacteria: Mechanisms and applications. *Scientifica*, 2012, 963401. PGPR Mechanisms
2. Lugtenberg, B., & Kamilova, F. (2009). Plant-growth-promoting rhizobacteria. *Annual Review of Microbiology*, 63, 541-556. PGPR Review
3. Haas, D., & Défago, G. (2005). Biological control of soil-borne pathogens by fluorescent pseudomonads. *Nature Reviews Microbiology*, 3(4), 307-319. Biocontrol by Pseudomonads
4. Trivedi, P., Leach, J. E., Tringe, S. G., et al. (2020). Plant-microbiome interactions: From community assembly to plant health. *Nature Reviews Microbiology*, 18(11), 607-621. Plant-Microbiome Interactions
5. García-Gómez, S., & Jansen, S. (2021). Molecular insights into plant-microbe interactions. *Frontiers in Bioscience*, 16(1), 9. Molecular Insights
6. Biswas, S., et al. (2024). Plant Growth Promoting Rhizobacteria (PGPR): Reports on Their Colonization, Beneficial Activities, and Use as Bioinoculant. *Advances in Agriculture*, 2024, 8173024. PGPR Colonization

138h



7. Singh, A., et al. (2024). The Roles of Plant-Growth-Promoting Rhizobacteria (PGPR)-Based Biostimulants for Agricultural Production Systems. *Agronomy*, 14(3), 550. PGPR Biostimulants
8. Yadav, A. N., et al. (2024). Role of Plant Growth Promoting Rhizobacteria (PGPR) as a Plant Growth Enhancer for Sustainable Agriculture: A Review. *Sustainability*, 16(7), 2750. PGPR for Sustainable Agriculture



The image shows five distinct handwritten signatures in black ink, arranged horizontally from left to right. The first signature on the left is 'NSH' with a diagonal slash. The second is a circular scribble. The third is a stylized 'A' or 'Q' shape. The fourth is a more complex, angular signature. The fifth is a signature that appears to be 'J' followed by a long horizontal stroke.

Course Title: Plant-Microbe Interactions

Credits: 4

Course Objectives:

1. To develop an in-depth understanding of the molecular, cellular, and ecological aspects of plant-microbe interactions.
2. To explore symbiotic and pathogenic relationships and their impact on plant physiology, immunity, and productivity.
3. To examine recent advances in genomics, transcriptomics, and metabolomics in the context of plant-microbe research.
4. To understand the role of beneficial microbes in sustainable agriculture, plant health, and climate resilience.
5. To equip students with critical thinking and research skills through literature analysis and case studies.

Learning Outcomes:

Upon successful completion of this course, students will be able to:

- Analyse complex interactions between plants and various microbial partners (bacteria, fungi, viruses).
- Evaluate the signaling mechanisms, genetic basis, and biochemical pathways involved in plant-microbe interactions.
- Design and interpret experiments using molecular and omics-based tools to study plant-microbe systems.
- Critically review recent literature and advances in the field.
- Propose sustainable solutions using beneficial microbes for crop improvement and stress management.

Course Content

Unit I: Fundamentals of Plant-Microbe Interactions

- Evolutionary drivers of plant-microbe associations: co-evolutionary dynamics and phylogenomic.
- Classification of interactions: mutualism, commensalism, parasitism, and context-dependent relationships.
- Advanced host specificity mechanisms: molecular recognition and receptor-ligand interactions.
- Multi-omics profiling of rhizosphere, phyllosphere, and endosphere microbiomes.
- Cutting-edge techniques: single-cell metagenomics and spatial transcriptomics for microbiome dynamics.

Unit II: Plant-Pathogen Interactions

- Advanced pathogenicity: effector-triggered susceptibility and non-host resistance mechanisms.
- Plant immune signaling: integration of PTI, ETI, and RNA-based immunity (e.g., siRNA pathways).

NSM


- Effector biology: structural diversity, delivery systems, and host-target interactions.
- Role of plant secondary metabolites, pathogenesis-related proteins, and volatile organic compounds.
- Functional genomics and CRISPR-based screens to identify resistance genes.

Unit III: Symbiotic and Beneficial Interactions

- Rhizobium-legume symbiosis: single-cell transcriptomics of nodulation and nitrogen fixation.
- Mycorrhizal symbiosis: molecular networks for nutrient exchange and stress signaling.
- Plant-growth-promoting microbes: mechanisms (e.g., quorum sensing, exometabolite production).
- Endophytes: multifunctional roles in immunity, stress tolerance, and secondary metabolism.
- Synthetic microbial communities: design and application for enhanced plant resilience

Unit IV: Molecular and Omics Approaches in Plant-Microbe Studies

- Single-cell omics and spatial transcriptomics for interaction analysis.
- Metagenomics and metatranscriptomics for microbial community profiling.
- Multi-omics integration: proteomics, metabolomics, and lipidomics in signaling pathways.
- CRISPR/Cas systems: gene editing for enhanced plant-microbe interactions.
- AI-driven bioinformatics: machine learning for microbiome data analysis and pathway modeling.

Unit V: Applications and Emerging Trends

- Microbiome engineering: synthetic biology for crop productivity and climate adaptation.
- Advanced biocontrol: microbial consortia and RNAi-based pest/pathogen management.
- Microbial solutions for abiotic stress: drought, salinity, and heat tolerance.
- Plant-microbe interactions in phytoremediation, carbon sequestration, and soil health restoration.
- Ethical, biosafety, and regulatory frameworks for microbial biotechnologies.

Recommended Readings

Textbooks & Reference Books

1. Smith, S. E., & Read, D. J. (2008). *Mycorrhizal Symbiosis* (3rd ed.). Academic Press.
2. Gnanamanickam, S. S. (2006). *Plant-Associated Bacteria*. Springer.
3. Agrios, G. N. (2005). *Plant Pathology* (5th ed.). Elsevier Academic Press.
4. Lugtenberg, B. (2015). *Principles of Plant-Microbe Interactions: Microbes for Sustainable Agriculture*. Springer.
5. Deshmukh, S. K., & Gupta, M. K. (2022). *Fungal Biotechnology and Bioengineering*. CRC Press.

M387

6. Berg, G., Rybakova, D., & Fischer, D. (Eds.). (2020). *Microbiome Applications in Agriculture*. Springer.

Review Articles

1. Barea, J. M., Pozo, M. J., Azcón, R., & Azcón-Aguilar, C. (2005). Microbial co-operation in the rhizosphere. *Journal of Experimental Botany*, 56(417), 1761-1778. Microbial Co-operation
2. Berendsen, R. L., Pieterse, C. M. J., & Bakker, P. A. H. M. (2012). The rhizosphere microbiome and plant health. *Trends in Plant Science*, 17(8), 478-486. Rhizosphere Microbiome
3. Vandenkoornhuysen, P., Quaiser, A., Duhamel, M., Le Van, A., & Dufresne, A. (2015). The importance of the microbiome of the plant holobiont. *New Phytologist*, 206(4), 1196-1206. Plant Holobiont
4. Hardoim, P. R., van Overbeek, L. S., Berg, G., et al. (2015). The hidden world within plants: ecological and evolutionary considerations for defining functioning of microbial endophytes. *Microbiology and Molecular Biology Reviews*, 79(3), 293-320. Microbial Endophytes
5. Vishwakarma, K., Kumar, N., Shandilya, C., et al. (2020). Revisiting plant-microbe interactions and microbial consortia application for enhancing sustainable agriculture: A review. *Frontiers in Microbiology*, 11, 560406. Sustainable Agriculture
6. García-Gómez, S., & Jansen, S. (2021). Molecular insights into plant-microbe interactions: A comprehensive review. *Frontiers in Bioscience*, 16(1), 9. Molecular Insights
7. Singh, L. P., Gill, S. S., Tuteja, N., & Gill, R. (2021). Plant-microbe interaction: Aboveground to belowground, from the good to the bad. *International Journal of Molecular Sciences*, 22(19), 10388. Aboveground to Belowground
8. Zhang, J., Liu, Y. X., Guo, X., et al. (2020). Insights into plant-microbe interactions in the rhizosphere to promote sustainable agriculture. *Trends in Agricultural Sciences*, 1(1), 1-12. Rhizosphere Insights
9. Glick, B. R. (2012). Plant growth-promoting bacteria: Mechanisms and applications. *Scientifica*, 2012, 963401. PGPR Mechanisms
10. Trivedi, P., Leach, J. E., Tringe, S. G., et al. (2020). Plant-microbiome interactions: From community assembly to plant health. *Nature Reviews Microbiology*, 18(11), 607-621. Plant-Microbiome Interactions

The bottom of the page features five handwritten signatures or initials in black ink. From left to right: the first is 'MSM' with a horizontal line underneath; the second is a stylized circular signature; the third is a simple, rounded signature; the fourth is a more complex, cursive signature; and the fifth is a signature that appears to be 'Rus' or similar.