MINISTRY OF SCIENCE AND HIGHER EDUCATION OF THE RUSSIAN FEDERATION
Federal State Autonomous Educational Institution of
Higher Education
"Ural Federal University named after the First President of Russia B.N. Yeltsin"

Institute of Natural Sciences and Mathematics

APPROVED BY
Vice-Rector for Research
A.V. Germanenko
«___» _____ 2023 г.

PROGRAM OF THE DISCIPLINE
PLANT BIOTECHNOLOGY

List of information about the program of the discipline	Credentials
Postgraduate Program Biotechnology	**Code PP** 1.5.6.
Group of specialties Biological Sciences	**Код** 1.5.
Federal State requirements (FSR)	Order of the Ministry of Science and Higher Education of the Russian Federation № 951 dated 20.10.2021.
Self-approved requirements (SAR)	Order "On the implementation of the "Requirements for the development and implementation of training programs for scientific and scientific-pedagogical personnel in the graduate school of UrFU" dated 31.03.2022 №315/03

Yekaterinburg
2023

The program of the discipline was compiled by the authors:

№	Full name	Academic degree, Academic title	Position	Affiliation
1	Alexander A. Ermoshin	PhD, Docent	Associate Professor	Department of Experimental Biology and Biotechnology of the Institute of Natural Sciences and Mathematics
2	Irina S. Kiseleva	PhD, Docent	Head of Department	Department of Experimental Biology and Biotechnology of the Institute of Natural Sciences and Mathematics

Recommended by:

Educational and methodological board of Institute of Natural Sciences and Mathematics

Head of the Educational and Methodological board of the Institute of Natural Sciences and Mathematics
Record № _1_ от 19.01.2023 г.

E. S. Buyanova

Agreed by:

Head of academic staff training department

E.A. Butrina

1. GENERAL CHARACTERISTIC OF THE DISCIPLINE " PLANT BIOTECHNOLOGY"

1.1. Annotation

Plant biotechnology is an important area of science and technology used in crop production, agriculture and forestry, and genetic engineering. This discipline is a logical continuation of the development of student's competencies in plant physiology, genetics and general biotechnology.

The purpose of the discipline "Plant Biotechnology" is to form the ability to perform research with isolated plant cells, their cultivation and use; and to understand the role of plant biotechnology in fundamental scientific knowledge and practical activities.

The study of the discipline involves the following tasks:

1. Mastering the methodology of research activities in the field of plant biotechnology;

2. Formation of skills in plant biotechnology: the use of plants and plant cell cultures as producers of biologically active substances or platforms for genetic engineering.

1.2. The language of study - English

1.3. Expected discipline outcomes

As a result of mastering the discipline, the PhD student should:

Know:

- main fields of plant biotechnology, achievements and prospects of its development;
- technical and engineering systems and conditions providing plant cell cultures;
- properties of cell cultures and patterns of their development.

Be able to:

- solve the problems of plant cell biology using traditional and modern methods of biotechnology;
- use the methods of plant cell sand tissues cultivation;
- reveal the influence of physical and chemical factors on the growth of the plant cell cultures.

Demonstrate skills and experience in:

- research in the field of plant biotechnology.

1.4.The scope of the training course

№	Types of academic work	Scope of the discipline		The distribution of the hours in the 4th semester
		Total hours	Including contact work (hours)*	
1	Lectures	4	4	4
2	Self-study work, including preparation for attestation	104		104
3	Semester attestation	Test	0.25	Test, 4
4	**Total scope, hours**	**108**		**108**
5	**Total scope, credits**	**3**		**3**

2. THE CONTENT OF THE COURSE

№	Topic	Content
T 1	Plant cell totipotency and callus cultures	Concept of totipotency, dedifferentiation and differentiation of cells. Single cell culture methods: nurse tissue, feeding layer, microdroplets. Types of differentiation and factors influencing them. The role of phytohormones in culture morphogenesis. Morphological characteristics of calluses. The use of callus culture.
T 2	Protoplast culture and somatic hybridization	Methods for protoplasts isolation: mechanical and enzymatic. Fusion of protoplasts: chemical and electrical methods. Heterokaryon. Characteristics of hybrid and cymbid cells. Distant hybridization. Practical application of somatic hybrids.
T 3	Characterization of the cell population in vitro. Suspension cultures	Obtaining and application of suspension cultures. Phases of culture growth. Batch and continuous cultivation. Determination of cell viability. Heterogeneity of cell population and factors determining it. Synchronization of the cell cycle.
T4	Somatic embryogenesis. Vitrification.	Advantages of somatic embryogenesis over organogenesis. Methods for obtaining somatic embryos. Stages of embryoid development. The concept of vitrification, methods of prevention.
T5	Somaclonal variability and cell technologies in plant breeding	Somaclonal variants. Causes of somaclonal variability. Application. Cellular plant breeding. Artificial mutagenesis in vitro. Cultures of anthers and ovules. Haploid cultures.
T6	Secondary metabolism of plants. Plant cell culture as a producer of biologically active substances	The concept of secondary metabolites. Classification of secondary compounds. The role of secondary compounds in plant life and for humans. Synthesis of secondary compounds in cell culture. Superproducers. Industrial cultivation of plant cells.
T7	plant genetic engineering	The concept of genetic engineering. Vectors in genetic engineering. Enzymes in genetic engineering. Stages of production and analysis of transgenic plants. Methods for introducing a transgene into a plant cell: agrobacterial and bio-ballistic transformation. Target, marker and selective genes. Constitutive, tissue-specific and inducible promoters. Transplastomic plants. Transient expression of genes. Evaluation of the presence and safety of GM components in food.

3. ORGANIZATION OF PRACTICE AND SELF-STUDY WORK

3.1. Practice

Not provided.

3.2. Approximate topic of independent work

3.2.1. Approximate list of essay topics

The assay should be an analytical review of the scientific literature on the candidate's dissertation.
- application of genetic engineering in agriculture
- genetic engineering of plants for pharmaceuticals. Green and edible vaccines.
- biosafety assessment of transgenic plants
- culture of hairy roots in biotechnology
- obtaining marker-free transgenic plants
- in planta plant transformation

The essay volume is 20-25 typewritten pages in A-4 format.

3.2.2. Approximate topics of individual or group projects

Not provided

4. THE SET OF TOOLS FOR INTERMEDIATE AND FINAL ATTESTATION

4.1. The evaluation criteria for the results of current and intermediate attestation

Approved evaluation criteria of the achievements are based on three levels of mastering the competence components: intermediate, advanced, and high.

Competence components	Characteristics of the level of development the components of competencies		
	threshold	**advanced**	**high**
Knowledge	A PhD student demonstrates knowledge-acquaintance, knowledge-copy: he recognizes objects, phenomena and concepts, finds differences in them, knows of the sources of information, can independently reproduce knowledge.	A PhD student demonstrates analytical knowledge: confidently reproduces and understands the acquired knowledge, classifies them into one or another classification group, independently systematizes them, establishes relationships between them, productively applies in common situation.	A PhD student can independently get new knowledge from the world around him, creatively use it to make decisions in new and non-standard situations.
Skills	A PhD student is able to correctly perform prescribed actions according to an instruction, an algorithm in a known situation, independently solve typical problems that require a choice from known methods in a predictably changing situation	A PhD student is able to independently solve non-standard tasks that require a choice based on a combination of known methods in an unpredictably changing situation	A PhD student is able to independently solve research problems, demonstrates the creative use of skills (technologies)
Personal qualities	A PhD student has a low motivation for studying, shows an indifferent, irresponsible attitude to learning, and assigned work	A PhD student has a pronounced motivation for studying, demonstrates a positive attitude towards learning and future work, and is active. `	A PhD student has a developed motivation for studying and work activities, shows perseverance and dedication, diligence, independence, and creativity.

4.2. The tools for current and intermediate attestation

Assessment of knowledge, skills and (or) experience that characterize step-by-step formation of competencies in the discipline "Plant biotechnology" is carried out in the form of current control and intermediate attestation. Current control is carried out during the semester in order to determine the level of assimilation of knowledge by PhD students, the formation of skills and abilities in the field of biotechnology. To assess knowledge, skills, abilities and (or) experience at the university, a point-rating system is used.

4.2.1. List of sample questions for attestation:

Not provided.

4.2.2. List of sample questions for the exam

1. The role of phytohormones in the morphogenesis of plant cells.
2. The phenomenon of dedifferentiation and differentiation of cells. Importance of cytokinins and auxins.
3. Morphological, genetic, biochemical. callus classification.
4. Cultivation of isolated plant cells.
5. Media for cultivation of plant cells. main components and their meaning.
6. The concept of asepsis. Sterilization of explats, media, utensils and instruments.
7. Curve of cell growth. Obtaining and application of suspension cultures.
8. Culture of apical meristems. Obtaining virus-free planting material.
9. Transgenesis. Concept, meaning.
10. Plant biotechnology for the conservation of genetic diversity. Gene banks.

5. EDUCATIONAL, METHODOLOGICAL, AND INFORMATIONAL SUPPORT

5.1. Recommended literature

5.1.1. Basic literature

1. Glick B.R., Pasternak J.J., Patten C.L. Molecular Biotechnology: Principles and Applications of Recombinant DNA 4th Edition - ASM Press, 2009 – 850 p.
2. Schmid R.D., Schmidt-Dannert C. Biotechnology: An Illustrated Primer 1st Edition - Wiley-Blackwell, 2016 – 410 p.
3. Kapiel T. Cell And Tissue Culture Laboratory Manual – MSA University, 2006 – 143 p. DOI: 10.13140/RG.2.1.3538.9289

5.1.2. Additional literature

1. Reinert J., Yeoman M.M. Plant Cell and Tissue Culture: A Laboratory Manual - Springer-Verlag, 1982 – 81 p.

5.2. Methodical manuals

not provided

5.3. Software

1. Microsoft office (Word, Excel, Power point);
2. Adobe Reader.

5.4. Databases and search systems

1. GenBank - http://www.ncbi.nlm.nih.gov/genbank/
2. PubMed - http://www.ncbi.nlm.nih.gov/pubmed/
3. Google scholar - https://scholar.google.ru/

4. Scopus - https://www.scopus.com/
5. eLibrary - http://elibrary.ru/

5.5. Electronic learning sources

1. Zonal scientific library http://lib.urfu.ru/course/view.php7idM67
2. UrFU electronic resources http://lib.urfu.ru/mod/data/view.php7id-2802
3. Library catalogue http://lib.urfu.ru/course/view.php7idM 81.

6. MATERIAL RESOURCES AND TECHNICAL SUPPORT

6.1. Information about the auditorium and laboratory equipment for the discipline

Ural Federal University has special rooms for lecture-type classes, group and individual consultations, current control and intermediate attestation, as well as rooms for independent work, equipped with computers with the access to the Internet and electronic information educational environment, and facilities for storage and preventive maintenance of equipment. Postgraduate students of the departments are provided with special rooms for research work.