

*Federal State Autonomous Educational Institution of Higher Education "Peoples'
Friendship University of Russia"*

Agrarian and Technological institute

Recommended by ISSC / ME

THE WORKING PROGRAM OF THE DISCIPLINE

Discipline name MOLECULAR AND BIOCHEMICAL MARKERS

Recommended for direction of training/specialties

06.06.01 "Biological Sciences"

(the code and name of the direction of training / specialty are indicated)

Focus of the program (profile)

03.02.07 Genetics

(name of the educational program in accordance with the direction (profile))

1. Goals and objectives of the discipline:

The purpose of the discipline is to develop the skills of graduate students in the use of molecular markers in the field of practical genetics and plant breeding, accelerate the breeding process using the latest genetic approaches, and create varieties of agricultural crops on their basis, as well as develop abilities focused on research work.

2. Place of discipline in the structure of EP VO:

"Molecular and biochemical markers", as a discipline, is included in the variable part of the Block 1 of the curriculum.

Table 1 shows the previous disciplines aimed at the formation of discipline competencies in accordance with the competence matrix of EP HE.

Table No. 1

Prior and subsequent disciplines aimed at the formation of competencies

P / p No.	Code and name of competence	Preceding disciplines	Subsequent disciplines (groups of disciplines)
Universal competences			
1	UC-1: the ability to critically analyze and evaluate modern scientific achievements, generate new ideas when solving research and practical problems, including in interdisciplinary fields	Research methodology Plant genetics	The genetic basis of plant immunity Plant breeding and biotechnology
General professional competencies			
1	GPC-1: the ability to independently carry out research activities in the relevant professional field using modern research methods and information and communication technologies	Plant genetics	The genetic basis of plant immunity Plant breeding and biotechnology
Professional competence			
1	PC-1: the ability to understand modern problems of biology and use fundamental biological concepts in the field of professional activity to formulate and solve new problems; PC-2: Ability to use basic theories, concepts and principles in the chosen field of activity, ability to think systems PC-3: readiness to independently analyze the available information, set the goal and objectives of the study and propose methods for their solution;	Plant genetics	Russian language in sphere professional communications The genetic basis of plant immunity Plant breeding and biotechnology

3. Requirements for the results of mastering the discipline:

The process of studying the discipline is aimed at the formation of the following competencies:

Universal Competencies (UC):

UC-1: the ability to critically analyze and evaluate modern scientific achievements, generate new ideas when solving research and practical problems, including in interdisciplinary fields

General professional competences (GPC):

GPC-1 - the ability to independently carry out research activities in the relevant professional field using modern research methods and information and communication technologies

Professional competencies (PC):

PC-1: Ability to understand modern problems of biology and use fundamental biological concepts in the field of professional activity to formulate and solve new problems

PC-2: Ability to use basic theories, concepts and principles in the chosen field of activity, ability to think systems

PC-3: readiness to independently analyze the available information, set the goal and objectives of the study and propose methods for their solution

As a result of mastering the discipline, a graduate student must:

know:

- use markers for selection, creation and evaluation of source material for breeding;
- the main methods of phenotypic, biochemical and molecular genetic marker analysis of the source and selection-significant material.

be able to:

- assess collection and selection material based on knowledge of phenotypic, biochemical and molecular genetic methods of marker analysis;
- to carry out phenotypic, biochemical and molecular genetic marker analyzes of the source and breeding material;
- to evaluate the correspondence of actually obtained data with theoretically expected ones.

4. Scope of discipline and types of educational work

The total workload of the discipline is 4 credit units.

Type of educational work	Total hours	Semesters			
		3	4		
Classroom lessons (total)	80	40	40		
Including:	-	-	-	-	-
Lectures	40	20	20		
Laboratory workshop	40	20	20		
Independent work (total)	46	23	23		
knowledge control	18	9	9		
Total labor intensity hour	144	72	72		
credits units	4				

5. Content of the discipline

5.1. Contents of discipline sections

Name of the discipline	Molecular and biochemical markers
Discipline scope	4 Credits / 144 hours
Discipline summary	
The name of the sections (topics) of the discipline	Summary of sections (topics) of the discipline

Repetitive DNA sequences as a source of plant genome diversity.	Types of DNA sequence mutations. Tandem repetitive DNA: the biology of mini- and microsatellites. Mobile elements.
Traditional marker systems	Protein markers. Allozymes.
Restriction fragment length polymorphism - RFLP analysis.	Nuclear RFLP (restriction fragment length polymorphism) and DNA fingerprinting. RFLP in chloroplast and mitochondrial DNA.
Molecular basis of RAPD.	Benefits, Limitations and Uses of RAPD Markers. Amplified regions characterized by sequencing. Quantification of gene expression using random primers. Properties of RAPD markers.
AFLP analysis and its varieties.	AFLP technique: principle, advantages and limitations. Expression analysis based on AFLP analysis. Various AFLP variations
Other molecular markers based on In Vitro DNA amplification.	S-SAP Analysis. Selective amplification of microsatellites. Polymorphic loci. Microsatellite-AFLP. Microsatellites. Addressed PCR. Analysis of the expression of genomic regions: RGAP, SRAP and TRAP. Analysis of polymorphism of single-stranded conformations, and related methods. Other techniques.

5.2. Sections of disciplines and types of classes

P / p No.	The name of the discipline section	Lecture	Practice.	knowledge control	Ind. work	Total hour.
one.	Repetitive DNA sequences as a source of plant genome diversity.	8	8	3	9	
2.	Traditional marker systems	8	8	3	9	
3.	Restriction fragment length polymorphism - RFLP analysis.	8	8	4	9	
4	Molecular basis of RAPD.	8	8	4	9	
5	AFLP analysis and its varieties. Other molecular markers based on In Vitro DNA amplification.	8	8	4	10	
Total labor intensity hour/ credits units		40	40	18	46	144
		144 / 4				

6. Laboratory workshop

P / p No.	Practical training topics	Labor capacity (hour.)
1.	Repetitive DNA sequences as a source of plant genome diversity.	8
2.	Traditional marker systems	8
3.	Restriction fragment length polymorphism - RFLP analysis.	8
4	Molecular basis of RAPD.	8
5	AFLP analysis and its varieties. Other molecular markers based on In Vitro DNA amplification.	8
Total		40

7. Practical (seminars) (*in the presence of*)

Approximate topics of course projects (works)

- Molecular certification of plant species and varieties
- Genomic plant breeding
- Marker-associated selection
- Multilocus markers in genetic mapping
- The use of molecular markers in selection and genetic research (on various agricultural and medicinal crops, depending on the topic of the dissertation work).

8. Material and technical support of the discipline:

- Specialized equipment for general use:
 - Water bath
 - Laboratory balance
 - pH meter
 - Heating table
 - Magnetic stirrer
 - Distiller
 - Autoclave
 - Centrifuge
 - Amplifier
 - Cameras, power supply, UV transilluminator for DNA gel electrophoresis and analysis
 - Laminar box

9. Information support of the discipline

a) software

Volume Licensing Program (Microsoft Subscription) Enrollment for Education Solutions (EES) No. 56278518 dated 04/23/2019 (renewed annually, the program is assigned a new number).

b) databases, reference and search systems

1. EBS of RUDN University and third-party EBS to which students have access on the basis of concluded agreements:

- Electronic library system RUDN - EBS RUDN <http://lib.rudn.ru/MegaPro/Web>
- EBS "University Library Online" <http://www.biblioclub.ru>
- EBS Yurayt <http://www.biblio-online.ru>
- EBS "Student Consultant" www.studentlibrary.ru
- EBS "Doe" <http://e.lanbook.com/>
- TUIS: <http://esystem.pfur.ru/course/view.php?id=46>

2. Database of biological publications:

- **Bulletin of RUDN University**: access mode from the territory of RUDN University and remotely <http://journals.rudn.ru/>
- **Scientific library Elibrary.ru**: access by IP-addresses of RUDN University at the address: <http://www.elibrary.ru/defaultx.asp>
- **ScienceDirect (ESD), "FreedomCollection", "Cell Press" ID "Elsevier"**. There is remote access to the database, access by IP-addresses of RUDN University (or remotely by individual login and password).
- **Google Academy (eng. Google Scholar)** - free search engine for full texts of scientific publications of all formats and disciplines. Indexes full texts of scientific publications. Access mode: <https://scholar.google.ru/>
- **Scopus** - scientometric database of publishing house "Elsevier". There is remote access to the database.

Access by IP-addresses of RUDN University and remotely by login and password (Grant of the Ministry of Education and Science). Access mode: <http://www.scopus.com/>

- **Web of Science**. There is remote access to the database. Access to the platform is carried out by IP-addresses of the RUDN University or remotely. Remote access to WOS is activated without administrator intervention after registering on the platform from RUDN University <http://login.webofknowledge.com/>
- Protein Data Bank, PDB Database - <http://www.rcsb.org> (open access)
- SWISS-PROT, UniProt the protein sequence data bank, UniProt database - <http://beta.uniprot.org> (open access)
- UniProt database on the server of the European Bioinformatics Institute (EBI) - <http://www.ebi.ac.uk/uniprot> (open access)
- Databases Swiss-Prot, TrEmbl, UniProt on the server ExpASY (Expert Protein Analysis System) of the Swiss Institute of Genomics and Proteomics SIB - <http://www.expasy.org> (open access)
- Classical and molecular biology - <http://molbiol.ru> (open access)
- Joint Center for Computational Biology and Genomics, and Proteomics, a Russian-language information site with web addresses and a brief description of molecular biological databases - <http://www.jcbi.ru> (open access)
- Practical Molecular Biology - <http://molbiol.edu.ru> (open access)
- Server of the US National Center for Biotechnology Information (NCBI): databases GenBank, NCBI Protein Database, UniGene, HomoloGene, etc. - <https://www.ncbi.nlm.nih.gov/> (open access)
- Server of the Molecule Modeling Center of the National Institutes of Health NIH, USA - <https://cmm.cit.nih.gov/>

3. Internet resources:

- Genetic Analysis / Eds. Griffiths AJF, Gelbart WM, Miller JH, Lewontin RC - <http://www.ncbi.nlm.nih.gov/book/genomic>
- Genomics / Brown E. 2nd ed. - <http://www.ncbi.nlm.nih.gov/book/genomic>
- Modern Genetic Analysis - <http://www.ncbi.nlm.nih.gov/book>
- Modern Genetic Analysis / Eds. Griffiths AJF, Gelbart WM, Miller JH, Lewontin RC - <http://www.ncbi.nlm.nih.gov/book/genomic>
- Molecular Cell Biology. / Eds. Lodish H., Berk A., Zipursky S. L., Matsudaria P., Baltimore D., Darnell D - <http://www.ncbi.nlm.nih.gov/book/genomic>

10. Educational and methodological support of the discipline:

a) main literature

1. Kuznetsov, V.V. Molecular genetic and biochemical methods in modern plant biology [Electronic resource]: textbook / V.V. Kuznetsov, V.V. Kuznetsov, G.A. Romanov. - Electron.

Dan. - Moscow: Publishing House "Laboratory of Knowledge", 2015. - 498 p.

<https://e.lanbook.com/book/66252...>

2. Molecular biology: laboratory practice / O.S. Korneeva, V.N. Kalayev, M.S. Nechaeva, O. Yu. Goikalova; scientific. ed. O.S. Korneeva; Ministry of Education and Science of the Russian Federation, Voronezh State University of Engineering Technologies. - Voronezh: Voronezh State University of Engineering Technologies, 2015. - 52 p. : ill. - Bibliography. in the book. - ISBN 978-5-00032-106-5; The same [Electronic

resource]. <http://biblioclub.ru/index.php?page=book&id=336018>

3. Biochemistry and molecular biology: teaching aid / auth.-comp. S.F. Andrusenko, E.V. Denisenko; Ministry of Education and Science of the Russian Federation, Federal State Autonomous Educational Institution of Higher Professional Education "North Caucasus Federal University". - Stavropol: SKFU, 2015. -- 94 p. : tab. - Bibliography. in the book. ; The same [Electronic resource] <http://biblioclub.ru/index.php?page=book&id=457873>

b) additional literature

2. Grierson D. ; Covey SN Plant molecular: Glasgow London: Blackie., 1988. -- 9, 233 p. <http://www.cnsbh.ru/intra/rdr.asp>

11. Methodical instructions for students on mastering the discipline (module)

Starting to study the discipline "Molecular and biochemical markers ", the graduate student should familiarize himself with the content of her work program.

The educational process for mastering the discipline includes: lectures, practical classes and independent work. All forms of teaching are compulsory. Throughout the course, it is recommended to pass test tasks on the TUIS platform: <http://esystem.pfur.ru>

For practical training, before being admitted to work in a molecular biological laboratory, it is necessary to undergo safety instructions from a responsible person. At the beginning of each session, laboratory equipment should be checked for visible damage. If damage is found, inform the teacher. At the end of each lesson, the teacher summarizes the implementation of the practical lesson and gives a topic for study for the next lesson. After each PZ, the postgraduate student performs cleaning of his workplace.

Independent work is an important element of postgraduate student training. The tasks of independent work are to acquire the skills of independent research work based on the analysis of the texts of literary sources and the use of various research methods; developing the ability to independently and critically approach the material being studied.

Working with educational and scientific literature is the main form of independent work and is necessary in preparation for the current control of knowledge or intermediate certification. It includes the study of lecture material, as well as the study of recommended sources and literature on the subject of lectures. When self-studying a theoretical topic, a graduate student, using the literary sources and electronic resources recommended in the RPD, must answer control questions or complete tasks suggested by the teacher.

Detailed information, including theoretical material, a glossary and a list of recommended literature for graduate students can be found on the TUIS platform: <http://esystem.pfur.ru...>

During the semester, current control of knowledge and intermediate certification of graduate students are carried out. Ongoing control is carried out at each practical lesson in the form of a selective, group or individual survey in oral or written form in order to check the formation of the competencies set forth in the FOS.

Features of the implementation of discipline for people with disabilities and people with disabilities.

Training in the discipline of disabled people and persons with disabilities (hereinafter HIA) is carried out by the teacher, taking into account the characteristics of psychophysical development, individual capabilities and health status of such students.

For students with musculoskeletal disorders and hearing disabilities, lectures will be accompanied by multimedia tools and handouts.

For students with visual disabilities, the use of technical means for enhancing residual vision is provided, and the possibility of developing audio materials is also provided.

In this discipline, training of disabled people and persons with disabilities can be carried out both in the classroom and remotely using the capabilities of the electronic educational environment (TUIS) and e-mail.

In the course of classroom training, various means of interactive learning are used, including group discussions, brainstorming, business games, project work in small groups, which makes it possible to include all participants in the educational process in active work on mastering the discipline. Such teaching methods are aimed at joint work, discussion, group decision-making, contribute to group cohesion and provide opportunities for communication not only with the teacher, but also with other students, cooperation in the process of cognitive activity.

Training of disabled people and persons with disabilities can be carried out according to an approved individual schedule, taking into account the characteristics of their psychophysical development and health status, which implies the individualization of the content, methods, pace of the student's learning activity, the ability to follow the specific actions of the student when solving specific problems, making the need, the required adjustments in the training process.

It provides for individual consultations (including counseling via e-mail), the provision of additional educational and methodological materials (depending on the diagnosis).

12. Fund of assessment tools for intermediate certification of students in the discipline (module)


Materials for assessing the level of mastering the educational material of the discipline (evaluation materials), including a list of competencies indicating the stages of their formation, a description of indicators and criteria for assessing competencies at various stages of their formation, a description of the assessment scales, typical control tasks or other materials necessary for the assessment of knowledge, abilities, skills and (or) experience of activity, characterizing the stages of the formation of competencies in the process of mastering the educational program, methodological materials that determine the procedures for assessing knowledge, skills, skills and (or) experience of activities that characterize the stages of formation of competencies, developed in full and available for students on the discipline page at TUIS RUDN.

Developers:

Associate Professor of Department
Of Agrobiotechnology
position, department name


signature E.V. Romanova
initials, surname

Director of Department
Of Agrobiotechnology
position, department name


signature E. N. Pakina
initials, surname

Program manager
Associate Professor of Department
Of Agrobiotechnology
position, department name


signature E.V. Romanova
initials, surname