

Ministry Agriculture of the Republic Kazakhstan  
Kazakh agrotechnical university named of S. Seyfullin

Considered at the meeting of the  
University Academic Council  
Protocol № 15  
«28» 05 2020

APPROVED  
by First Vice Chairman of the Board  
of «S. Seifullin Kazakh  
AgroTechnical University» NCJSC  
A. M. Abdyrov  
\_\_\_\_\_ 2020



**EDUCATIONAL PROGRAM**  
**"GENETICS AND SELECTION OF CROPS»**

Education area code and classification: 8D08 Agriculture and bioresources  
Code and classification training areas: 8D081 Crop  
Code in the International standard classification of education: 0812  
Awarded degree: doctor of philosophy (PhD) , specialty "Genetics and  
selection of crops»  
Duration of training: 2 years

Nur Sultan, 2020

**Authors:**

Name Place	Place of work	Position, academic degree, title
Amantayev Beczak Omir zakovich	KATU named after S. Seifullin	Head of the Department, candidate of agricultural Sciences
Stybaev Ghani Zhasymbekovich	KATU named after S. Seifullin	candidate of agricultural Sciences, Professor
Kipshakbaeva Gulden Amangeldinovna	KATU named after S. Seifullin	candidate of agricultural Sciences, senior lecturer
Rysbekova, Aiman Bokenovna	KATU named after S. Seifullin	candidate of agricultural Sciences, associate Professor
Zhumagulov Iglic Imang alievich	KATU named after S. Seifullin	candidate of agricultural Sciences, docent

The team of authors approved by the order of S. Seifullin KATU NCJSC No. 932-H of 12.12.2018.

The educational program "Genetics and selection of crops" was reviewed at a meeting of the Department "Agriculture and Crop Production" Protocol No. 9 of "20" may 2020, approved by the Council of the Agronomy Faculty Protocol No. 10A "26" may 2020.

The Dean of the faculty of agronomy

Head of the Department



Stybaev G. J.

Amantayev B. O.

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## **1 Passport of the educational program**

### **1.1 Purpose of the educational programme**

The educational program "Genetics and selection of crops" is created taking into account the requirements of the labor market.

The main purpose of the program is to train specialists able to formulate and solve modern scientific and practical problems in the professional sphere, to carry out teaching, research and professional activities in the field of agriculture.

The objectives of the educational program - the study and application of theoretical and methodological foundations in the field of genetics and selection of crops; the formation of research, teaching and professional competencies in the field of agriculture

### **1.2 General characteristics of the educational program (relevance, features, competitive advantages, uniqueness, stakeholders, etc.).)**

The educational program "Genetics and selection of crops" is designed on the basis of a modular system of studying disciplines and consists of 2 modules that form General cultural and professional competence in the scientific and pedagogical direction. The educational program involves fundamental, educational, methodological and research training and in-depth study of disciplines in agricultural areas of education for higher and postgraduate education and enterprises of agriculture.

The educational program contains a course of theoretical training, including the study of cycles of basic and core disciplines; additional types of training: pedagogical and research practice, research work of a doctoral student, including the implementation of a doctoral dissertation, as well as the final certification - a comprehensive exam and design and defense of a doctoral thesis.

The relevance of the educational program "Genetics and selection of crops" is the need to prepare scientific and scientific-pedagogical personnel of higher qualification, capable of innovation in the field of science, education and production. Accordingly, the PhD student must develop the skills of independent research and teaching activities, as well as other competencies necessary for successful work in the field of agricultural activity.

The educational program is designed to train specialists with a high level of professional culture, able to formulate and solve modern scientific and practical problems in the educational sphere, to successfully carry out teaching, research and management activities.

For the wide implementation of the educational program requires qualified specialists in this field.

The uniqueness of the educational program in the training of specialists to carry out activities to study the phenomena of heredity and variability at all levels, the use of genetic laws in breeding with the skills of working in the laboratory and in the field hospital. Ability to analyze the information, generalization and systematization. The educational program combines all areas of modern biology, which are a key factor in the progress in the study of complex biological processes and systems at the molecular, cellular, organizational and population levels.

## **2 Competence model (portrait) of the graduate**

### **2.1 Scope of professional activity**

The sphere of professional activity of PhD doctoral student of the educational program "Genetics and selection of crops" - scientific, pedagogical, administrative and industrial activities in the field of agriculture in particular:

- local and Republican state institutions, as well as various types of agricultural formations (individual, collective, farms, joint-stock companies, limited liability partnership, production cooperatives, etc.);

- educational activities in higher, secondary special, vocational educational institutions of agricultural and biological profile, scientific and managerial activities in scientific and industrial institutions, in the apparatus of local, regional, national structures.

### **2.2 Professional activities:**

- organizational and technological;

- research;

- production and management;

- design and expert;

- industrial-technological;

- pedagogical

Specific types of professional activity of the graduate is determined jointly with the interested participants of the educational process.

### **2.3 Core competencies**

PhD doctor in the educational program "Genetics and selection of crops" should possess the following basic competencies:

***know:***

- on modern methods and techniques used in the selection process of crops;

- on scientific concepts of world and Kazakhstan science in the relevant field;
- organization of the selection process;
- the principles and trends of the direction, the latest discoveries and developments and the prospects of their use in the educational process and research;
- norms of interaction in the scientific community;
- pedagogical and scientific ethics of the researcher;
- on the principles of management processes in the field of education and science.

***know:***

- basic elements of the field experience methodology;
- basic principles of field experience data processing;
- the impact of field experience techniques on his mistake;
- current trends, trends and patterns of development of domestic science in the context of globalization and internationalization;
- methodology of scientific knowledge;
- achievements of world and Kazakhstan science in the relevant field;
- foreign language for scientific communication and international cooperation;

***know:***

- apply the obtained theoretical knowledge and practical experience in conducting independent, fundamental and applied research;
- formulate and solve problems arising in the course of professional and research activities;
- modern means of communication, computer technology, as well as prospects and trends in the development of information technologies in the field of higher and special education;
- to plan, establish and carry out a scientific experiment;
- maintain documentation and reporting on the experiment;
- conduct phenological and other related observations of the growth and development of crops during their growing season;
- to apply in the course of work methods and techniques of diagnostics of level of stability of plants;
- to quantify the effect of extreme factors on plants (temperature, concentration of substances in the environment, water potential, etc.);
- to evaluate agronomic resistance of the variety to stress (percent or other units characterizing the ratio of plant productivity under stress to their yield in the absence of stress pressure);

- to assess the physiological state of plants, adaptation potential and determine the factors for improving the growth, development and quality of products using the knowledge of plant resistance to adverse environmental factors;
- to process the results, analyze and comprehend them taking into account the literature data;
- to apply rules, methods and means of preparation of technical documentation and scientific reports.

***have the skills:***

- planning, organization and implementation of experimental scientific activities;
- public speech;
- scientific and business letters;
- formulation of goals, tasks related to the implementation of professional functions, making specific management decisions to achieve the goals;
- patent search;
- protection of intellectual rights;
- bookmarks of field experience, method of experiment planning;
- knowledge of crossing techniques;
- crop accounting and methods of pre-processing of experimental data;
- processing of long-term data of field experiments;
- the use of modern methods and techniques, the ability to see and establish the relevance of scientific problems in the field of physiology and biochemistry of plants;
- acquisition of new knowledge, development of new technologies and management tools:
- use of General scientific methodology, logic and technology of scientific research.

***be competent:***

- in carrying out scientific, theoretical and experimental research in the field of higher and special education;
- in matters of scientific methodology, the use of modern software products, processing of the results and forms of their presentation;
- in the key issues of organization, planning, implementation; all types of professional activities in the field of higher and special education;
- to the practical use of in-depth knowledge in the field of scientific activity;
- independently carry out research activities in the relevant professional field using modern research methods and information and communication technologies;

-critical analysis and evaluation of modern scientific achievements, generation of new ideas in solving research and practical problems, including in interdisciplinary areas.

## **2.4 Professional competences**

### ***know:***

- on modern scientific methods;
- advanced technical means and methods for use in the breeding process;
- trends and directions of development and prospects of their use;
- modeling of crop varieties;
- on the principles of organization of management processes;
- on the mechanism of implementation of scientific developments in practice;
- norms of interaction in the scientific community;
- on the pedagogical and scientific ethics of the researcher.

### ***Know:***

- stress and adaptation – General characteristics of the phenomena;
- classification of stressors (biotic and abiotic nature);
- reception of a stress signal plants;
- signal transduction paths;
- participation of hormones in signal transduction;
- plant responses to stressors;
- specific and non-specific reactions;
- stress proteins and their functions;
- fundamentals of physiological stability of plants at the molecular, cellular, organizational and cenotic levels;
- the concept of variety and its importance in agricultural production;
- classification of the source material according to the degree of breeding study, hybridization, mutagenesis, polyploidy and haploidy;
- selection methods, selection of the most important properties, organization and technique of the breeding process;
- technique of variety testing of field crops;
- theoretical basis of seed production, nature and technology cartoony and renovation;
- schemes and methods of production of elite seeds, seed production system of individual crops;
- system of placement and introduction in production of seeds of the best zoned grades, varietal allowances at sale of seeds, schemes and methods of



receiving elite seeds of self-pollinating, cross-pollinating and vegetatively propagating plants;

- varietal and seed control in seed production;

- modern technologies of cultivation of crops based on morphological and biological requirements, taking into account climatic and agroecological conditions of the zone;

- on the main methods and methods of obtaining the optimal yield for a particular agricultural situation;

- on the organization and implementation of production processes during the cultivation of field crops, taking into account the possibility of managing the productivity of crops and the quality of the products, using modern agricultural machinery, chemical and agrotechnical means of protecting seeds and plants;

- on the integration of the main provisions and methods used in agriculture, Agrochemistry in crop production, in solving professional problems;

- methodology and methodology of teaching in institutions of higher and special education and scientific experiments;

- modern means of communication, computer technology, prospects and trends in the development of information technologies in the field of higher and special education;

- fundamentals of Economics, labor organization, higher and special education, production and research.

***know:***

- use modern methods of selection;

- conduct individual and mass selection of field crops;

- know the technique of crossing;

- evaluate varieties on economic grounds;

- carry out the calculation of seed areas for crops;

- fill in documents on breeding and seed production;

- to organize primary seed production and improvement of varieties in the process of primary seed production;

- to grow elite varieties of grain and leguminous crops;

- grow the seeds in fertile and sterile counterparts of lines of corn;

- to grow virus-free elite of potatoes with the use of clonal selection;

- draw up documentation for varietal crops;

- to choose effective methods and ways of performance of tasks on management of quantity and quality of the received crop production;

- analyze the problems and processes of the technological plan;

-to apply the received theoretical knowledge and practical skills in the implementation of pedagogical activity, independent fundamental and applied research;

-formulate and solve problems arising in the course of professional, research and teaching activities that require in-depth professional knowledge;

-to present the results of the work done in the form of reports, reports, abstracts, articles, designed in accordance with the existing requirements, with the involvement of modern editing and printing;

-to contribute their own original solutions, research, expanding the boundaries of scientific fields and educational programs.

***have the skills:***

-sampling, source material, documentation for varietal crops;

-testing of field crops;

-for individual and mass selection of seeds;

-to manage the productivity of crops, to take into account the dangers and threats arising in the process of cultivation, compliance with the basic requirements of agricultural technologies;

- scientific communication;

- use of General scientific methodology logic and technology of research work with the design of its results in various forms of scientific products.

***be competent:***

- in the field of scientific and scientific-pedagogical activity in the conditions of rapid updating and growth of information flows;

- in carrying out theoretical and experimental research in the field of crop breeding;

- in the formulation and solution of theoretical and applied problems in scientific research;

- in carrying out a professional and comprehensive analysis of the problems in the selection of crops;

- in matters of interpersonal communication and human resource management;

- in matters of University training;

- in the examination of scientific projects and research;

- to ensure continuous professional growth.

## 5 The structure of the educational program of master's degree in scientific and pedagogical direction

№	Name of cycles of disciplines and activities	Total labor intensity	
		in academic hours	in academic hours
1	2	3	4
1.	Theoretical training		
1.1	The cycle of basic disciplines (DB)	450	15
	including a high school component:		
1	Methodology and methods of scientific experiments in agronomy	150	5
2	Pedagogical practice	150	5
	including optional component:		
1	Physiological basis of plant resistance	150	5
1.2	Cycle of major disciplines (PD)	1140	38
	including a high school component:		
1	Innovative technologies in crop breeding	180	6
2	Theoretical aspects of breeding and seed production of field crops	180	6
3	Research practice	600	20
	including optional component:		
1	Crop productivity and crop quality management	180	6
	Research work of the doctoral student, including the implementation of the doctoral dissertation	3450	115
	Final certification (IA)	360	12
	Design and defense of master thesis (Osmd)		
	Subtotal	5400	180



## Annex 2. Working curriculum

WORKING CURRICULUM																																						
For the modular education program "Genetics and selection of crops"																																						
In specialty D131 - -																																						
Course years 2020-2023																																						
Degree : Doctoral studies by specialization (scientific & pedagogical direction)																																						
Form of education: Full-time (PhD 3 years) trimester																																						
Entry year : 25-05-2020																																						
Module code	Module name	Discipline cycle	Discipline component	Code of subject	Subject name	Academic credits	Control by semesters				Volume of hours			Self-study work of PhD student with teacher (office)	Self-study work of PhD student	Distribution of study hours by semester/terms/quarters																						
							Exams	Differentiated test(practice)	Differentiated test(course paper)	Total	In-class learning	including				Number of weeks in the semester/term/quarter																						
												Lectures	Practice												Lab practicals													
1	2	3	4	5	6	7	8	9																														
<b>Modules of specialty/education program</b>																																						
1	Selection of agricultural crops	BS	ES	FOUR 7204	Physiological bases of plant resistance	5	1			150	50	1/20	2/30		1/20	5/80	10																					
2		AS	ES	ITSSK 7302	Innovative technologies in the breeding of crops	5	1			150	50	1/20	2/30		1/20	5/80	10																					
3		AS	UC	TASSPK 7301	Theoretical aspects of plant breeding of field crops	5	1			150	50	1/20	2/30		1/20	5/80	10																					
4	Research practice	BS	UC	PP 7201	Pedagology practice	10				0	0						10																					
5		BS	UC	IP 7202	Research practice	5				0	0							10																				
6		BS	UC	IP 8203	Research practice	5				0	0									10																		
7	Research techniques	BS	UC	MNI 7205	Methods of scientific researches	5	1			150	50	1/20	2/30		1/20	5/80	10																					
8		BS	UC	AP 7206	Academic writing	5	2			150	50	1/20	2/30		1/20	5/80	10																					
<b>Scientifically research</b>																																						
9	Research practice	RW	CS	NIRDVVDD 7501	PhD student's research work, incl. doctoral thesis	5				0	0						10																					
10		RW	CS	NIRDVVDD 7502	PhD student's research work, incl. doctoral thesis	15				0	0							10																				
11		RW	CS	NIRDVVDD 8503	PhD student's research work, incl. doctoral thesis	15				0	0								10																			
12		RW	CS	NIRDVVDD 8504	PhD student's research work, incl. doctoral thesis	20				0	0									10																		
13		RW	CS	NIRDVVDD 8505	PhD student's research work, incl. doctoral thesis	20				0	0										10																	
14		RW	CS	NIRDVVDD 9506	PhD student's research work, incl. doctoral thesis	20				0	0											10																
15		RW	CS	NIRDVVDD 9507	PhD student's research work, incl. doctoral thesis	20				0	0												10															
16		RW	CS	NIRDVVDD 9508	PhD student's research work, incl. doctoral thesis	8				0	0																											
<b>Total of theoretical course</b>						25	5	0	0	750	250	100	150	0	100	400																						
AC	<b>Additional courses</b>					143																																
PP	Teaching practice					10	60		2																													
RP	Research practice					10	60		3, 4																													
PhDSR	PhD student's research work, incl. doctoral thesis					123	738		2, 3, 4, 5, 6, 7, 8, 9																													
FA	<b>Final attestation</b>					12																																
	Doctoral dissertation design and defence					12		9																														
	<b>Total</b>					180				6300	250	100	150	0	100	400																						

## Description of compulsory subjects and University components

Name of discipline	Methodology and methods of scientific experiments in agronomy
2. Numberofcredits	5
3. Prerequisites:	Basic and specialized disciplines of magistracy
4. Post-requisites:	Disciplines of the cycle of major disciplines
5. Competences:	<p><i>Know:</i></p> <ul style="list-style-type: none"> <li>-on fundamental and applied Sciences of agrarian direction and regularities of their development;</li> <li>-achievements of domestic and foreign scientists in the field of agronomic Sciences;</li> <li>-on the methods of teaching agronomic disciplines in higher education.</li> </ul> <p><i>know:</i></p> <ul style="list-style-type: none"> <li>- basic elements of the field experience methodology;</li> <li>- basic principles of field experience data processing</li> <li>- on the impact of field experience techniques on his mistake.</li> </ul> <p><i>know:</i></p> <ul style="list-style-type: none"> <li>- to plan, establish and carry out univariate and multivariate experiments;</li> <li>- maintain documentation and reporting on field experience; conduct phenological and other related observations of the growth and development of agricultural crops during their growing season;</li> </ul> <p><i>have the skills:</i></p> <ul style="list-style-type: none"> <li>- bookmarks of field experience, experiment planning;</li> <li>- methods of crop accounting and methods of preliminary processing of experimental data;</li> <li>- principles of processing of long-term data of field experiments.</li> </ul> <p><i>be competent:</i></p> <ul style="list-style-type: none"> <li>- in the practical use of in-depth knowledge in the field of scientific agronomy.</li> </ul>
6. The author of the course	Nogaev A. A. PhD doctor
7. Basicliterature	<p>1.Mozhaev N. And ... Serikpayev N. Ah. Stybaev G. Zh. Fundamentals of scientific research in agronomy. Astana, 2010.</p> <p>2.Mozhaev N. And ... Serikpayev N. Ah. Forage production. Astana, 2007.</p> <p>3.Mozhaev N. And ... Serikpayev N. Ah. Workshop on feed production. Astana, 2007.</p> <p>4.Nikitenko G. experimentation in agriculture. M., 1982.</p> <p>5.Tomilov V. P. Workshop on experimental methods. Tselinograd, 1983.</p> <p>6.Dospekhov B. A. Technique of field experience. M., Agropromizdat, 1985.</p>

	<p>7.Methods of experiments on hayfields and pastures. M., Ed. Unicorn, 1971.</p> <p>8.Methods of state variety testing of agricultural crops. M., 2011</p>
<p>8. Course content Introduction (course review). General idea of the content and composition of the course. The content of the concepts of scientific agronomy, methodology, history methodology. Increasing the volume and quality of primary crop production without harming the environment as a target function of agriculture. The goal of scientific agronomy is to gain new knowledge about methods and means of increasing production. The content of the concepts of scientific agronomy, methodology, history methodology. Increasing the volume and quality of primary crop production without harming the environment as a target function of agriculture. The goal of scientific agronomy is to gain new knowledge about methods and means of increasing production. Philosophical and theoretical basis of agronomic research methodology. The structure of modern scientific agronomic research. Logical foundations of scientific research. General scheme of transfer of agronomic innovation in agriculture.</p>	

Name of discipline	Innovative technologies in crop breeding
2. Number of credits	6
3. Prerequisites:	plant physiology, botany, Cytology, biochemistry, genetics, plant breeding, Microbiology, molecular biology.
4. Post-requisites:	Disciplines of the cycle of major disciplines
5. Competences:	<p><i>Know:</i></p> <ul style="list-style-type: none"> <li>-the technology used in plant breeding and seed production of agricultural crops;</li> <li>-the achievements of domestic and foreign scientists breeding and seed crops.</li> </ul> <p><i>know:</i></p> <ul style="list-style-type: none"> <li>- genetics and plant breeding, molecular genetics;</li> <li>- the main methods of phenotypic, biochemical and molecular genetic marker analysis of the source and selection-significant material;</li> <li>- basic principles of molecular labeling technologies for DNA nucleotide sequence polymorphism: RAPD, RFLP, AFLP, SSR, ISSR, CAPS, SNP and their applications;</li> <li>- theoretical basis and basic modern methods of phenotypic, biochemical and molecular genetic marker analysis used in crop breeding.</li> </ul> <p><i>know:</i></p> <ul style="list-style-type: none"> <li>- the ability to operate modern equipment and equipment for molecular genetic laboratory work;</li> <li>- use and determine the appropriate molecular genetic method for their own research, analysis of the results and their interpretation;</li> <li>- to know the methodology of theoretical and experimental research in the field of biotechnology (molecular labeling), selection and genetics of agricultural crops;</li> <li>- to assess the collection and breeding material on the basis of knowledge of phenotypic, biochemical and molecular genetic methods of marker analysis;</li> <li>-apply various methods of genetic marker analysis in breeding</li> </ul>

	<p>to create new varieties and hybrids of agricultural plants;  - to predict the results of the application of methods of phenotypic and molecular genetic marker analysis based on the characteristics of the initial and prospective breeding material involved in the breeding process.  -own:  system thinking, the ability to generalize, analyze, perceive information, setting goals and choosing ways to achieve it, the ability to compare, summarize, the results of their own research and available scientific data on issues;  <i>Acquire practical skills:</i>  -critical analysis, solutions in non-standard situations , the use of innovative technologies in science and production;  -formulate appropriate conclusions;  -use of practical and theoretical knowledge to solve professional problems in a particular activity;  -definition of tasks of own professional development.</p>
6. The author of the course	Djataev S. A. C.b.N.
7. Basic literature	<p>1.Goncharov, N. P. Methodical bases of plant breeding/Institute of Cytology and genetics; Ed. 2-e, PE rerab. and DOP. – Novosibirsk :Akad. geo publishing house, 2009. – 427 p.  2.Khlestkina E. K., Salina E. A. SNP-markers: methods of analysis, methods of development and comparative characteristics on the example of soft wheat // Genetics. – 2006. – Vol. 42, № 6. – P. 725-736.  3.Shavrukov Yu. N. CAPS-markers in plant biology // Vavilov journal of genetics and selection. – 2015. – Vol. 19, № 2. – P. 205-213.  4.Barker G.L.A., Edwards K.J. A genome-wide analysis of single nucleotide polymorphism diversity in the world's major cereal crops // Plant Biotechnology Journal. – 2009. – V. 7, № 4. – P. 318-325.  5.Berkman P.J., Lai K., Lorenc M.T., Edwards D. Next-generation sequencing applications for wheat crop improvement // American Journal of Botany. – 2012. – V. 99, № 2. – P. 365-371.  6.Bevan M.W., Uauy C. Genomics reveals new landscapes for crop improvement // Genome Biology. – 2013. – V. 14, № 6. – 206.  7.He C., Holme J., Anthony J. SNP genotyping: the KASP assay // In: Crop Breeding: Methods and Protocols. Methods in Molecular Biology / Fleury D., Whitford R. (Eds.). – New York: Springer, 2014. – V. 1145. – P. 75-86.  8.Kilian A., Huttner E., Wenzl P., Jaccoud D., Carling J., et al. The fast and the cheap: SNP and DArT-based whole genome profiling for crop improvement // In: Proceedings of the International Congress ‘In the Wake of the Double Helix: From the Green Revolution to the Gene Revolution’, 27-31 May, 2003 / Tuberosa R., Phillips R.L., Gale M. (Eds.). –</p>



	<p>Bologna, Italy: Avenue Media, 2005. – P. 443-461.</p> <p>9.Kumar S., Banks T.W., Cloutier S. SNP discovery through Next-generation sequencing and its applications // International Journal of Plant Genomics. – 2012. – V. 2012. – 831460.</p> <p>10.Kumpatla S.P., Buyyarapu R., Abdurakhmonov I.Y., Mammadov J.A. Genomics-assisted plant breeding in the 21st century: Technological advances and progress // In: Plant Breeding / Abdurakhmonov I. (Ed.). – Rijeka: InTech, 2012. – P. 131-184.</p> <p>11.Mammadov J., Aggarwal R., Buyyarapu R., Kumpatla S. SNP markers and their impact on plant breeding // International Journal of Plant Genomics. – 2012. – V. 2012. – 728398.</p> <p>12.Mohan M, Nair S, Bhagwat A, Krishna TG, Yano M, Bhatia CR, Sasaki T. Genome mapping, molecular markers and marker-assisted selection in crop plants // Molecular Breeding. – 1997. – V. 3, № 2. – P. 87-103.</p> <p>13.Paux E., Sourdille P., Mackay I., Feuillet C. Sequence-based marker development in wheat: advances and applications to breeding // Biotechnology Advances. – 2012. – V. 30, № 5. – P. 1071-1088.</p> <p>14.Salgotra R.K., Gupta B.B., Stewart J.C.N. From genomics to functional markers in the era of next-generation sequencing // Biotechnology Letters. – 2014. – V. 36, № 3. – P. 417-426.</p> <p>15. Semagn K., Bjørnstad A, Ndjiondjop M.N. An overview of molecular marker methods for plants // African Journal of Biotechnology. – 2006. – V. 5, № 25. – P. 2540-2568.</p> <p>16.Semagn K., Babu R., Hearne S., Olsen M. Single nucleotide polymorphism genotyping using Kompetitive Allele Specific PCR (KASP): overview of the technology and its application in crop improvement // Molecular Breeding. – 2014. – V. 33, № 1. – P. 1-14.</p> <p>17.Thomson M.J. High-throughput SNP genotyping to accelerate crop improvement // Plant Breeding and Biotechnology. – 2014. – V. 2, № 3. – P. 195-212.</p>
<p>8. <i>The content of the discipline</i></p>	<p>Modern plant breeding is based on the use of various molecular markers. The course outlines the basic principles and principles for all types of molecular markers used in plant breeding: from traditional to modern. Special attention is paid to the automated system of molecular markers. Additional information about genes of quantitative traits, expression and regulation of genes, as well as the role of epigenetics and genetic transformation in modern plant breeding creates a complete picture of students about the main areas of research in this field. The course is aimed at the practical application of modern methods in plant breeding in Kazakhstan.</p>

## Description of elective courses

Name of discipline	Crop productivity and crop quality management
2. Number of credits	6
3. Prerequisites:	Disciplines of the cycle of major disciplines
4. Post-requisites:	Basic and specialized disciplines in the specialty
5. Competences:	<p><i>Know:</i></p> <ul style="list-style-type: none"> <li>-on the processes of production and production of crop products.</li> <li>- <i>know:</i> organization of the process of crop production, based on the goals and ways of its achievement; the way control the productivity of crops and quality of crop production, increasing soil fertility and protecting the environment, on the basis of satisfying the requirements of the crops to environmental factors and the availability of them in the specific conditions of production. The essence and importance of information on crop productivity management in the development of modern technology of cultivation.</li> </ul> <p><i>know:</i></p> <ul style="list-style-type: none"> <li>-use the basic provisions and methods used in crop production in solving professional problems;</li> <li>-to design zonal agricultural technologies for different crops corresponding to their morphological and biological requirements;</li> <li>-to choose effective methods and ways of performance of tasks on management of quantity and quality of the received crop production;</li> <li>-analyze the dynamics of the formation of elements of productivity of field crops;</li> <li>-use the essence and importance of information on crop productivity management in the development of modern cultivation technology;</li> <li>-to take into account the dangers and threats arising in this process of cultivation, to comply with the basic requirements of agricultural technologies.</li> </ul> <p><i>-own:</i></p> <ul style="list-style-type: none"> <li>-systems thinking;</li> <li>-the ability to generalize, analysis, information perception, goal setting and choice of ways of its achievement,</li> <li>-the ability to compare, summarize, the results of their own research and available scientific data on issues;</li> <li>-the main methods, methods and means of obtaining optimal yields with high quality for a particular agricultural situation;</li> <li>-professional orientation in the conditions of frequent change of technologies of cultivation of field cultures taking into account requirements of today.</li> </ul> <p><i>Acquire practical skills:</i></p> <ul style="list-style-type: none"> <li>-critical analysis of adaptive technology for specific production conditions;</li> </ul>

	<p>-to find solutions in non-standard situations of crop productivity management using the best practices of science and production;</p> <p>-formulate appropriate conclusions;</p> <p>-use of practical and theoretical knowledge to solve professional problems in a particular activity;</p> <p>-definition of tasks of own professional development;</p> <p>-development of recommendations and introduction of advanced elements of adaptive technology of cultivation of field crops in specific production conditions.</p>
6. The author of the course	Shestakova N. Ah. Ph. D.
7. Basic literature	<p>1. Shestakova N. A. Gordeeva E. A. Managing productivity of crops and quality of crop production, Astana, 2017;</p> <p>2. Arinov K. K., Shestakova N. Ah. Crop Production Of Northern Kazakhstan. Astana, 2009;</p> <p>3. Arinov K. K., Musynov K. M., Shestakova N. A. Serikbaev N. A. Aushev A. K.. Crop, Astana "Foliant" 2016</p>
8. The content of the discipline the Prospect of development of the crop industry on the basis of adaptive technologies. Comparative characteristics of technologies of cultivation of the leading cultures of the Republic with world technologies (European States, Canada, USA, China, etc.). Features and dynamics of crop formation by field crops (cereals, legumes, oilseeds, potatoes, etc.) taking into account environmental conditions, environmental and agrotechnical factors. Principles of crop productivity and crop quality management. Agrobiological control of crops and the quality of the products.	

Name of discipline	Theoretical aspects of breeding and seed production of field crops
2. Number of credits	6
3. Prerequisites:	Basic and specialized disciplines of magistracy
4. Post-requisites:	Basic and specialized disciplines in the specialty
5. Competences:	<p><i>know:</i></p> <p>- about modern requirements and tasks of selection and seed-growing process.</p> <p><i>know:</i></p> <p>-Theoretical basis and modern methods of selection and seed crops:</p> <p>-basics of seed certification;</p> <p>-on the organization of the breeding process and seed;</p> <p>-requirements for sowing material;</p> <p>-research methods in breeding and seed production,</p> <p>-methods of selection and use of crop varieties.</p> <p><i>Know:</i></p> <p>-Apply different selection methods;</p> <p>-carry out analyses of varietal material;</p> <p>-varietal and species weeding;</p> <p>to predict the processes of cartony based on the characteristics of the varieties and effectiveness of their implementation;</p> <p>-organize seed varieties;</p> <p>-prevent loss of yield and varietal properties of varieties;</p>

	<p>-to possess modern technologies of improvement of seed material and preparation of seeds for sowing.</p> <p><i>-own:</i></p> <p>-systems thinking;</p> <p>-ability to generalize, analyze, perceive information;</p> <p>-setting goals and choosing ways to achieve them;</p> <p>-the ability to compare, summarize, the results of their own research and available scientific data on issues.</p> <p><i>Acquire practical skills:</i></p> <p>-critical analysis of adaptive technology for specific production conditions.</p>
6. The author of the course	Djataev S. A. C.b.N.
7. Basic literature	<p>1.Vedrov N. D. Selection and seed production of field crops: studies. POS. / N. D. Buckets. - Krasnoyarsk: SFU, 2008. - 300 p.</p> <p>2.Sozinov A.V. Selection and seed production of agricultural plants: guidelines for laboratory and practical training. Lesnikovo:KGSHA. 2014,-64.S. AFR.</p> <p>3.Gulyaev G. V. Selection and seed production of field crops / G. V. Gulyaev, Yu. L. Guzhov. - M.: Agropromizdat, 1987. - 447 p.</p> <p>4.Organization and technique of the breeding process: method. instructions / Comp.: O. V. Parkina, E. L. Leibolt, V. V. Piskarev. - Novosibirsk, Publishing house of Novosibirsk state agrarian University, 2011. - 25 p.</p> <p>5.Pylnev V. V. practical Work on selection and seed production of field crops Tutorial / V. V. Pylnev. and others - M.: Kolos, 2008. - 448 p.</p>
<p>8. Course content: Methods of selection. Mass selection. Individual selection. Assessment of selection intensity. Intraspecific and interspecific hybridization. Principles of selection of pairs for hybridization. Types of crosses. The method and technique of hybridization. Mutagenesis in plant breeding. Physical and chemical mutagenesis. The concept of polyploidy, types of polyploids. Practical use of polyploids. Method of preparation and isolation of polyploids. Aneuploidy and haploidy. Heterosis selection. Methods of evaluation of breeding material. Create self-pollinated lines. Production of hybrid seeds. Classification of evaluation methods. Organization of selection process and variety testing. The technique of competitive trials, the types of competitive trials. Definition of seed production. The history of the development of seed production. The theoretical basis of seed growing. Variety and heterosis hybrid as the main objects of seed production. Causes of deterioration of varietal seeds and maintaining the purity of the variety. Organization of seed production. Method of reproduction of culture and organization of seed. Primary seed production. Organization of seed production on an industrial basis. Scheme and methods of production of original seeds. Varietal and seed control. Varietal control. General provisions of the method of testing of grain and leguminous crops. Seed control. Documentation of varietal seeds. Cortosone and strain renovation. Principles and terms of variety renewal and variety replacement. Accelerated reproduction of new and promising varieties. The concept of the category of seeds (original seeds, elite seeds, reproductive seeds, and reproductive seeds for commercial purposes). Technology of production of high-quality seeds. Storage of varietal seeds. Sampling of seeds of grain crops to determine the sowing qualities of seeds. Documentationforseeds.</p>	

Name of discipline	Physiological basis of plant resistance
2. Number of credits	5
3. Prerequisites:	Cytology, genetics, plant physiology, ecology, biochemistry, biotechnology
4. Post-requisites:	Basic and specialized disciplines in the specialty
5. Competences:	<p><i>know:</i></p> <ul style="list-style-type: none"> <li>- on modern methods and means of assessing the physiological properties of plant resistance.</li> </ul> <p><i>know:</i></p> <ul style="list-style-type: none"> <li>- General characteristics of stress and adaptation of the body;</li> <li>- reception stress signal plants;</li> <li>- participation of hormones in signal transduction, plant responses to stressors;</li> <li>- specific and non-specific reactions of plants.</li> </ul> <p><i>know:</i></p> <ul style="list-style-type: none"> <li>- apply in the course of work methods and techniques for diagnosing the level of stress and plant resistance;</li> <li>- maintain documentation and reporting experience;</li> <li>- conduct phenological and other related observations of the growth and development of agricultural crops during their growing season;</li> </ul> <p>have the skills:</p> <ul style="list-style-type: none"> <li>- bookmarks of field experience, experiment planning;</li> <li>- crop accounting and pre-processing of experimental data.</li> </ul> <p><i>be competent:</i></p> <ul style="list-style-type: none"> <li>- in the practical use of in-depth knowledge in the field of scientific agronomy.</li> </ul>
6. The author of the course	Seitkaziev A. I. D. b.N., Professor
7. Basic literature	<ol style="list-style-type: none"> <li>1. Alekhina N. D., Balnokin Y. V., Gavrilenko V. F., et al., plant Physiology, 2nd ed., Rev. M: Publishing center "Academy", 2007 – 640 p.</li> <li>2. Metlitsky L. V., Ozeretskovskaya O. L. As plants are protected from diseases. M: Publishing house of Science, 1985 192 p.</li> <li>3. Polesskaya O. G. Plant cell and reactive oxygen species M: KDU publishing House, 2007. 139 PP.</li> <li>4. Selye G. At the level of the whole organism. M.: Publishing house of Science, 1972, 122 p.</li> <li>5. Tumanov I. I. Physiology of hardening and frost resistance of plants. M.: Publishing house of Science, 1979. 350 PP.</li> <li>6. Hochachka P., Somero J. Biochemical adaptation. M.: publishing house of the World. 1988. 568 p.</li> <li>7. Diagnosis of plant resistance to stress. (methodological guidance.) Additional literature. Leningrad, 1988, 228s.</li> <li>8. Balnokin V. Ion homeostasis and osmoregulation from</li> </ol>

	<p>halotolerant microalgae. //Plant physiology, 1993, volume 40, vol.4, 567-576.</p> <p>9.Merzlyakov Said M. N. The activated oxygen and the vital functions of plants // Soros obrozovatelnoy journal, 1999, No. 9, No. 20-26.</p> <p>10.Albersheim P., Darvill A. G. Oligosaharidy // V mire nauki, 1985, No. 11 pp. 16-23.</p>
<p>8. Plants are often exposed to stressors – adverse environmental factors. The state in which the plant is under the influence of a particular stressor is called stress. Stressors are the abiotic and biotic proishozheniya. Abiotic stressors include lack of moisture (drought), extreme temperatures (high and low), high content of ions in the soil (soil salinization), hypoxia (lack of oxygen), very high and very low illumination, ultraviolet radiation, high content of toxic gases (SO<sub>2</sub>, NO<sub>2</sub>, O<sub>3</sub>) in the atmosphere and a number of others. Stressors of biotic nature are pathogens – pathogenic fungi, bacteria and viruses, as well as herbivorous insects. Under sustainability understand the ability of plants to maintain the constancy of the internal environment (to maintain homeostasis) and to carry out the life cycle in the conditions of action of stressors.</p>	