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PRECONDITIONS OF SEEDS' PRODUCTION ENHANCEMENT: A CASE STUDY

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Abstract. The article reveals the current state of selection and seed production of grain crops in the Russian Federation. There were considered the barriers of the development of the subsector in the conditions when one of the priorities is the creation of export-oriented grain production, which is not possible without well-developed plant breeding and seed production. There were revealed the features of selection and seed production of grain crops in modern conditions: underfunding of organizations engaged in selection, lack of breeding laboratories in the field of genetic technologies, imperfection of legislation in the country, low level of material and technical support of seed production, illegal seed trafficking, lack of financial opportunities of agricultural producers to conduct timely the variety exchange and variety renewal. There were proposed the measures to improve the system of state regulation in the field of selection and seed production of grain crops to solve these problems.

Keywords: grains; selection; seed growing; barriers of development; biotechnology; state regulation, Russian Federation

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JEL Classifications: O13, O32, Q16, Q18

Additional disciplines: law

1. Introduction

The solution of the problem of ensuring food independence of Russia directly depends on the level of development of selection and seed production of grain crops. In accordance with the Decree of the President of the Russian Federation on August 6, 2014 No. 650 "On the application of certain special economic measures to ensure the security of the Russian Federation", there was introduced the law which bans the supply of certain types of agricultural products and food to Russia from countries that have announced sanctions against Russian legal entities and individuals. The current situation has determined the task of import substitution in the agro-industrial complex of the country, which is reflected as a priority in the "Long-term strategy of the development of the grain complex of the Russian Federation until 2035" (Long-term strategy 2019). Of course, it concerns the

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sphere of plant breeding and seed production of grain crops (On complex of immediate measures directed to the provision of accelerated development of domestic selection and seed production. 2019).

Behind the apparent prosperity of the country's self-sufficiency in grain seeds and leguminous crops (at the level of 86.8% for the 2018 harvest), the share of imported seeds for such an important grain crop as corn reaches 49%. According to a number of experts, domestic selection with the exception of crops, cereals, is in a state of deep crisis and is not able to compete with world leaders (Mayorov, 2019).

One of the main barriers in the development of grain selection in Russia is the prohibition of sowing of genetically modified seeds and agricultural crop hybrids in production (Federal law from 3th of July 2016).

For this reason, the development of domestic varieties and hybrids takes a longer period of time and does not always ensure their resistance to adverse environmental factors due to the underdevelopment of genetic innovations. It causes an increasing lag of crop production in Russia from the world's main agricultural leaders. However, in the long term, it may be beneficial to our country, because of the demand for non-genetically modified products (hereinafter, GMOs) in the coming years, according to researches of the Institute of Statistical Researches and Economic Science (ISRES) of the Higher School of Economics (hereinafter, HSE) will actively grow (Kolyanina, 2019).

According to A. M. Medvedev, the Deputy Minister of the Ministry of Education and Science of Russia, leading research institutions of grain crop selection in the country are the following: FSBRI "National Grain Center named after P. P. Lukyanenko" (Krasnodar Territory), FSBRI "Agricultural Research Center "Donskoy" (Rostov region), FSBRI "Research Institute of Agriculture of the South-East" (Saratov region), FSBRI "Omsk Agricultural Research Center" and others. Thus, researches in the field of plant breeding and seed crops are conducted by 615 researchers, including 76 Doctors of Sciences, 286 PhD, 50 graduate students in subordinate institutions of the Ministry of Education and Science of the Russian Federation (Medvedev, 2019).

The relevance of the study determines the need to identify barriers of development in order to improve the selection and seed production of grain crops in the Russian Federation. During the study of the subject, the authors used the following research methods: foresight (expert assessment of existing barriers of development and areas of improvement of selection and seed crops), comparative analysis (in the study of areas of state support), monographic (to assess the system of state regulation of the studied subsector of crop production).

2. Results

The sequence and intensity of selection process is primarily determined by the biology of grain crops and coefficient of its reproduction. Based on these prerequisites, a specific program of selection of a particular grain crop should be developed in the breeding center, ensuring the withdrawal of the appropriate variety or hybrid in a certain period with specified economic and valuable characteristics. One of the main challenges for selection and seed production of grain crops is to ensure the growth of quantitative indicators with a rapid increase in the quality parameters of produced seeds.

The employees of related science branches are taken part in the creation of new varieties and hybrids of grain crops: phytopathologists, agronomists, biophysicists, genetic engineers and other specialists (Dolferus et al. 2011).

The efficiency of selection process is a complex category that reflects the effectiveness of the selection center to create new varieties and hybrids, taking into account the use of production means, live labor and return of total investments. In general, the scheme of selection work with self-pollinating crops is presented in Figure 1.

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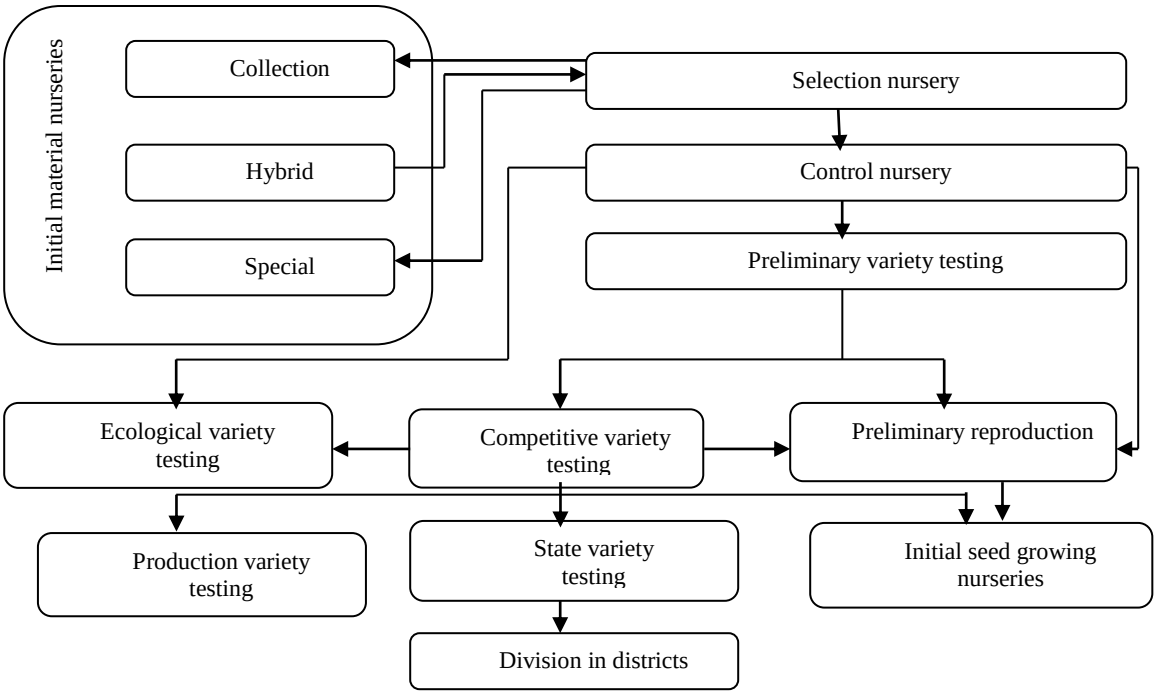

Fig. 1. Scheme of selection work with self-pollinating grain crops
Source: compiled by the authors based on (Nechaev, 2000)

The objective of selection of self-pollinating crops consists of selection of homozygous highly productive plants, assessment of their progeny and production on their basis of a new variety. In contrast to self-pollinating crops, the selection process of cross-pollinated plants, and in particular corn, is based on the use of the heterosis effect, that is, it is all connected with the creation of hybrid combinations and hybrids for industrial purposes. Figure 2 shows a diagram of the breeding process for cross-pollinating crops.

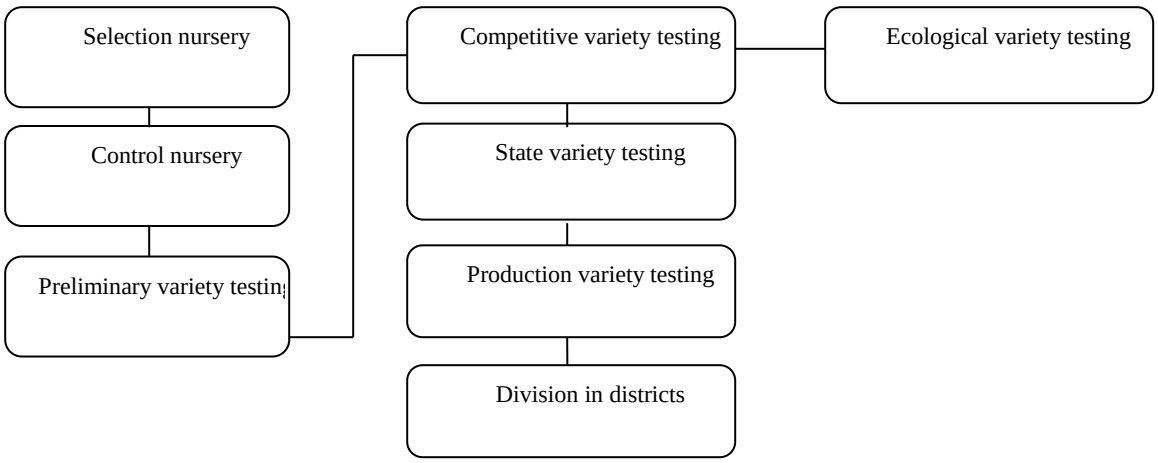

Fig. 2. Scheme of selection process with cross-pollinating cultures
Source: made by the authors on the basis (Nechaev, 2000)

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2020 Volume 7 Number 4 (June)
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It should be noted that one of the promising directions abroad is the production of hybrids and self-pollinating crops on the basis of heterosis. Thus, according to Akel W. and other scientists (Akel et al. 2019) there were selected the hybrids of durum wheat with high yield potential and good grain quality. However, hybrid breeding is not widely used in the real sector of the economy due to the difficulties in hybrid seed production.

It is evident that selection of grain crops is difficult and labor-consuming process demanding considerable financial and intellectual expenses from the given figures. Therefore, it is no accident that the HSE Technology Transfer Centre launched a research project “Selection 2.0”. This project is aimed at studying all aspects of the functioning of breeding and seed industry in Russia, it is planned to analyze the state of competition in the Russian Agro-Industrial Complex during its implementation, to work out possible options of mechanisms of public and private cooperation in crop selection and work with genetic resources.

As a result, experts should work out the structure of the chain of selection products value, identify growth points, barriers and ways of development of selection and seed growing industry. At the same time, it is planned to update the level and depth of Russia’s technological dependence, identify priorities for state efforts to support the technological development of the subsector. Unfortunately, the initiators of the project did not specify why this project was designated 2.0. We realize that the innovative development of agricultural industries today takes place during the fourth industrial revolution “Industry 4.0”. These are not new technologies, but new approaches to production and consumption, which are based on the collection of big data (Espolov, 2019). Therefore, why this research project designated as "Selection 2.0" is not entirely clear.

The working group is headed by Roman Kulikov, Deputy Director of the Digital Agrolaboratory “Skoltech”. It also included the Executive Director of the Association of Seed Potato Producers - Gennady Rezviy, Sergey Goncharov, professor of the department of selection and seed production of Voronezh State Agrarian University, Doctor of Agriculture, Sergey Platonov, political coordinator of the Federal Union of Plant Breeders of Germany in the Russian Federation, expert of the National Union of Plant Breeders and seed growers (Kulikov, 2019).

Modern biotechnology is just a new tool in the development of grain crop selection - the most effective variant of traditional selection (Conway, 2000; Ortiz et al., 2008). Therefore, it is no accident that the area under biotechnological (genetically modified) crops in the world has increased 110 times for 22 years. Thus, if in 1996 the area under these crops did not exceed 1.7 million hectares, in 2017 these figures increased to 189.8 million hectares (ISAAA Briefs 53-2017). This growth indicates that methods of biotechnology ensure the sustainability of agricultural production on the basis of specialized selection (Lammerts van Bueren et al. 2018).

It should be noted that plant breeders of Russia have created dozens of grain crop varieties with genetic potential of more than 10 tons per 1 hectare by classical methods. But these varieties do not realize their potential due to extreme environmental factors: lack of water in soil and air, severe clogging, soil salinity, epiphytotic diseases and pests. These varieties and hybrids of cereals can be given the properties of tolerance to above stress factors by means of genetic engineering methods, which require the joint work of plant breeders and genetic engineers.

The corresponding member of RAS A. A. Tishkov (Tishkov, 2019) states that in the world of genetics, already now, new genetically modified (GM) crops work not only to protect, for example, corn from pests, but also to change the strategy of photosynthesis, water regime and other areas, adapting new gene modifications to modern environmental conditions. Thus, according to Conway G. (Conway, 2000) biotechnology will become an important partner for farmers if crop yield limits increase significantly without excessive dependence on pesticides, will be resistant to drought, salinization and can use other nutrients more efficient. Anton Paul Wasson, R.A. Richards, R. Chatrath, S.C. Misra and other researchers pointed to it (Wasson et al., 2012).

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2020 Volume 7 Number 4 (June)
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In addition to traditional methods of genetics and selection to improve the efficiency of selection and seed production in recent decades, modern methods of marker selection are widely used for many varieties of agricultural plants, the use of which contributes to the acceleration of the selection process. With the help of marker-oriented selection methods, it is possible to solve the problems of crop resistance to various pathogens and stress factors more effectively (Richards et al., 2010).

Due to A. V. Alabushev, academician of the RAS, (Alabushev, 2019) in spite of specific success of domestic selection, high-yield wheat varieties, barley, rice, corn hybrids and other grain crops are not genetically protected from such diseases as ear physariosis, dusty and sound smut, blistered smut, leaf diseases, root rots and others. There is an increase in the number of insect pests, their activation and migration in the Northern direction. Everywhere there is an increase in populations and harmfulness of aphids, cicadas, thrips, cereal flies, bread beetles. The harmfulness of the bug-turtle, which has 4 morphological types, does not decrease and the expansion of the distribution area in Northern and Eastern regions of the country is revealed. The use of varieties genetically similar to the genes of resistance and susceptible to diseases and pests can lead to yield losses in the production.

The increase in risks in agricultural production leads to an increase in the number of late-ripening varieties, the share of which is more than 30 percent. Modern varieties and hybrids of grain crops do not always have sufficient quality of output products, mainly due to shortcomings in the preparation of seeds and technologies of their cultivation.

Table 1. Category of spring grain seeds and leguminous crops in the entities of the Russian Federation in 2019

Region	Total sown, th/tons	Category of seeds, th/tons		Percent of original, elite and reproduction seeds to sown seeds
		Original and elite	Reproductive (1-4)	
RUSSIAN FEDERATION	**5503,2**	**629,2**	**3480,8**	**74,68**
Costroma region	8,8	1,5	3,0	51,14
Smolensk region	22,9	2,4	10,7	57,21
Tula region	66,5	4,1	42,9	70,68
Vologda region	28,7	3,6	21,1	86,06
Kaliningrad region	6,7	0,5	4,4	73,13
Republic of Mari El	26,0	2,5	11,8	55,00
Udmurtia Republic	70,0	12,7	41,2	77,00
Kirov region	72,7	8,6	56,3	89,27
Orenburg region	278,9	25,6	145,2	61,24
Sverdlovsk region	91,4	9,0	55,7	70,79
Altai Republic	9,5	0,8	3,7	47,37
Khakass Republic	18,9	1,0	13,1	74,60
Kemerovo region	121,8	8,6	49,1	47,37
Buryat Republic	15,5	1,5	10,9	80,00
Sakha Republic (Yakutia)	4,5	0,3	3,5	84,44
Trans-Baikal Territory	25,0	0,5	4,8	21,20

Source: compiled by the authors based on (Nekrasov, 2019)

It follows that the percentage of original elite and reproductive seeds of grain and leguminous crops to their total number in the whole of the Russian Federation amounted to 74.7 percent from the data of Table 1. This indicates that the remaining 25.3% of the acreage is sown with seeds of mass reproductions or unknown origin. In the regions of Russia, this figure varied from 89.3% in Kirov region to 21.2% in Trans-Baikal Territory.

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2020 Volume 7 Number 4 (June)
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These problems should be solved by conducting selection to increase the potential of productivity and quality of output products, as well as winter hardiness, precocity, resistance of plants to dangerous pathogens and pests, drought resistance, resistance to other adverse factors. In addition, adaptive selection should be used to create fundamentally new varieties, increase the efficiency of crop production in the regions of the country, as well as the application of the principles of agro-economic zoning of varieties and hybrids. For this purpose, it is of particular importance to conduct fundamental and priority applied researches in the field of botany, genetics, physiology, biochemistry, immunity, biotechnology to obtain new results and create modern methods of effective assessment of the gene pool, modification and development of new methods of comprehensive study of grain crops in order to identify and use optimally the potential of hereditary variability of important economic characteristics in selection, breeding and creation of genetic sources and donors of original effective alleles of genes of resistance to stressors, productivity, quality and other economically valuable signs and also formation of collections of the identified gene pool for development of fundamental researches, traditional and new directions of selection, isolation and synthesis of fundamentally new donors and genetic sources with increased resistance to bio - and abiotic factors, high productivity, product quality and other economically useful features.

The development of the domestic grain market along with the selection of grain crops is directly related to the improvement of legislation regulating the field of seed production.

The legislation of the Russian Federation in the field of seed production of agricultural crops is extremely imperfect in comparison with the legislation of countries with significantly developed crop production, including Russia's neighbors - the countries of the former Soviet Union, which import a large volume of falsified seeds on the domestic market, seeds that do not correspond to varietal and sowing qualities, seeds without documents.

Legislation in the field of seed production should be focused on compliance by the legal entities, individual entrepreneurs and individuals with mandatory requirements at the production, certification, sale, storage and transportation of seeds of agricultural plants intended for the production of agricultural products, which is the basis of food security of the State.

In any country with a developed system of seed production, there is a law regulating activities in the field of seed production.

The state regulation of this sphere of activity is carried out in the EEU member states, according to their national legislation: the Law of the Republic of Armenia from 16.06.2005 No. ZO-106 "On seeds", the Law of the Republic of Belarus from 2.05.2013 No. 20-3 "On seed production". Law of the Republic of Kazakhstan No. 385-11 from 8 February 2003 "On seed production". Law of the Kyrgyz Republic No. 38 from 19.06.1997 "On seeds".

In other countries:
•USA. Code of Federal regulations published in the Federal register by agencies of the Federal government. Section 7 "Agriculture" (Electronic Code of Federal Acts. 2019);
•Canada. RSC, 1985, s. S-8 "Law on seeds" (Law on seeds (R. S. C., 1985, p. S-8));
•PRC. "Law on seeds" People's Republic of China 2004 (The law "On seed production" of People's Republic of China 2004);
• The European Union has adopted 12 directives regulating the requirements for sale and quality of seeds and planting material of agricultural plants (Legislation of the EU on marketing of seed and plant material).
All of the above countries, according to the International Federation of Seed Trade (IFST) have the highest volume of seed exports in the amount of 100 to 1500 million us dollars annually. At the same time Russian organizations purchase seeds annually worth more than 400 million US dollars (Dankwert, S.A. 2019).

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2020 Volume 7 Number 4 (June)
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Currently, the mechanism of protection of intellectual property in the field of selection and seed production in Russia is regulated by Chapter 73 of the fourth part of the Civil Code of the Russian Federation, including the protection of selection achievements.

In accordance with paragraph 36 of the Plan of measures to improve supervisory and licensing functions and optimizing the provision of public services by Federal executive authorities in the sphere of agriculture, approved by the Decree of the Government of the Russian Federation of March 9, 2010 № 299-r of the Ministry of Agriculture of Russia jointly with concerned agencies developed the draft of the Federal law "On amendments to the Federal law "On seed production and some other legislative Acts of the Russian Federation" (hereinafter - the Law).

This draft of the law is aimed at improving the legislation of the Russian Federation in the field of seed production, including the creation of conditions for the development of effective seed market, informing domestic producers and consumers of seeds about varietal resources, the availability and quality of seeds produced in the Russian Federation.

The draft of the Federal law "On amendments to the Federal law "On seed production and some other legislative Acts of the Russian Federation" is currently finalized on the comments of the Ministry of Justice of Russia and the Institute of legislation and comparative law under the Government of the Russian Federation contained in the relevant findings and is being prepared for submission to the government of the Russian Federation.

The state program of the development of agriculture and regulation of markets of agricultural products, raw materials and food approved by the resolution of the Government of the Russian Federation of July 14, 2012 No. 717 (further - the State program) provides measures of state support, including on development of seed production.

In order to stimulate the use of agricultural producers as a priority competitive domestic seed and planting material, technological equipment and materials since 2015 the reimbursement of direct costs incurred for the creation and (or) modernization of selection and seed centers in crop production has been provided. This measure of state support contributes to improving the competitiveness of domestic agricultural products in domestic and foreign markets as well as increasing the growth rate of agricultural products.

Since 2017, the subsidy has been provided for the provision of unrelated support for the reimbursement of costs to carry out a complex of agrotechnological works per 1 hectare of acreage for the production of corn seeds.

The possibility of obtaining preferential short-term loans to purchase seeds and also preferential investment loans for the period from 2 to 8 years on building, reconstruction and modernization of selection and seed production centers were provided by the order of the Ministry of Agriculture of Russia from January 24, 2017 No. 24 "On approval of lists of directions of target use of short-term preferential loans and preferential investment loans".

Support of elite seed production carried out within the framework of the "integrated" subsidy (Annex No. 9 to the State program) helps to increase the area occupied by varietal crops as well as to improve the quality of seed material produced.

The establishment of additional measures of state support for agricultural producers as well as organizations and individual entrepreneurs, scientific organizations, professional educational organizations, educational organizations of higher education engaged in the production of domestic agricultural products, its primary and (or) subsequent (industrial) processing can contribute to the development of domestic selection and seed production of agricultural plants.

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2020 Volume 7 Number 4 (June)
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Also due to the Decree of the President of the Russian Federation of July 21, 2016 No. 350 "On measures on realization of state scientific and technical policy in development of agriculture" there was developed the Federal scientific-technical program of development of agriculture in 2017-2025, approved by the Decree of the Government of the Russian Federation of 25 August 2017. No. 996 (hereinafter, FSTP), which is aimed at the production of original and elite seeds of agricultural plants in the direction of domestic crop production, which currently has a high degree of dependence on seeds of foreign production.

Employees of the Federal State Budgetary Scientific Institution of the Federal scientific center "All-Russian Research Institute of Agricultural Economics" proposed the principles of interaction between the participants of the FSTP (government, business, scientific institutions and universities) (Polunin, 2019):
● selection of participants implementing priority directions (from science, education, business);
● concentration of human, land and financial resources in priority areas;
● organization of transfer of selection achievements from science, education into production and control of their movement;
● business participation in the financing of science and education in priority areas of development and on a parity basis;
● Project financing of implementation of priority directions including with participation of support funds of scientific, scientific-technical, innovation activity and other institutes of development, such as the JSC "Rosagrolizing" and the JSC "Rosselkhozbank".

The next significant barrier in the considered FSTP is restraining factors of the implementation of public-private partnership:
-weak material and technical base of scientific organizations participating in state complex plans of scientific researches (further-CPSR) and complex scientific and technical programs (further-CSTP) which is economically unfavorable to develop for business, because any investments of the latter don't become its property, but only the gift which is burdensome for scientific and educational organizations;
- place of a consumer of scientific products of state research institutions and higher schools will be specify;
- insufficient volume of state support of researches and working outs of participants in CPSR and CSTP;
- whole range of possible ways of achieving the main goal in the field of selection and seed growing of agricultural crops.

We consider it expedient to propose changes to the CSTP:
- to endow the head executor of the CSTP with the status of a customer of scientific developments created by state scientific institutions;
- customer of scientific development makes a technical specification for the production of scientific products;
- customer finances the development of scientific products at the expense of received state subsidies and own funds in the proportion of 50-50;
- exclusive rights to the results of intellectual activity created within the framework of the CSTP are distributed between a customer and a contractor in equal shares. At the same time, the Ministry of Agriculture reserves the right to obtain a non-exclusive license, provided that the project participants do not use the results of intellectual activity protected by the patent in practice.

Academician A.V. Alabushev (Alabushev, 2019) notes that today in Russia there is an organizational scheme of seed crops, providing for the implementation of varietal renewal once every 4-5 years, which corresponds to the production of at least elite seeds in the amount of 5% of the total need in seeds. However, most producers do not have necessary financial possibilities to provide high-quality seed material, even their own production. Therefore, seeds of low sowing conditions do not create insurance and changing seed funds.

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Seeds of low sowing conditions and mass reproductions even in the presence of a high level of agricultural technology, favorable climatic and soil conditions reduce yields. Studies have shown that the contribution of the quality of seeds used in sowing to gross grain production is 11-19%. Up to 15-20% of the crop yield is lost annually when using low-quality seeds in sowing due to the lack of changing funds.

Dynamics of sowing of conditioned seeds of cereal crops in the Russian Federation in 2007 -2019 is presented in Figure 3.

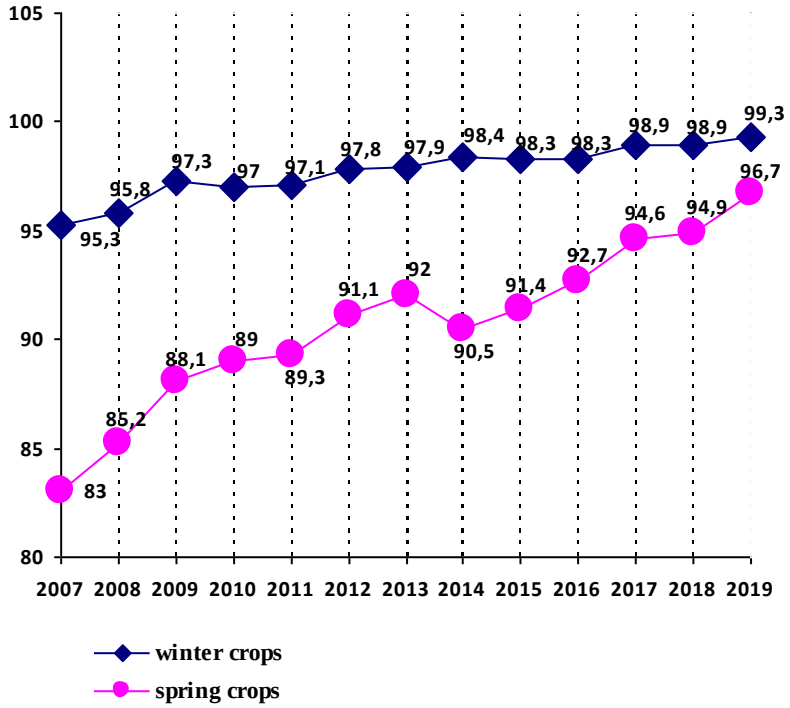

Fig. 3. Dynamics of sowing of conditioned seeds of cereal crops in the Russian Federation since 2007 to 2019, %
Source: compiled by the authors based on (Nekrasov, 2019)

From the data of Figure 3, it can be seen that the number of conditioned seeds of cereal crops increased for the period from 2007 to 2019. So if, this rate changed from 95,3 to 99,3% at winter grain crops, and from 83,0 to 96,7% at spring crops respectively.

In the complex of measures for the rise of grain production, an important place should be occupied by the variety exchange, as the cheapest and most affordable factor of intensification of grain production. At the same time, despite the high genetic potential of modern varieties, it is not always possible to obtain sufficiently high yield of grain crops. Therefore, due to the accelerated introduction of new varieties, there are real opportunities for sustainable growth of grain yields.

The main internal barrier in seed production is the problems accumulated in recent years: low level of material and technical support of primary seed production; lack of specialized small-sized equipment and modern complexes of post-harvest refinement of original and elite seeds; violation of agrotechnological requirements on seed crops; existence of illegal trafficking of seeds; low marketability of seeds of most crops, due to the lack of

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necessary funds from agricultural producers for the purchase of high-quality seed material. They are forced to move to on-farm seed production at growing seeds in farms that do not have the necessary material and technical base and qualified personnel. We can observe the slow introduction of new varieties into production due to poor controllability of processes of variety exchange and variety renewal. In this regard, it is advisable to improve the zonal technologies of primary and industrial seed production, ensuring the production and high yield of high-quality seeds, accelerated introduction of new varieties and hybrids into production.

The lack of a well-established mechanism of implementation of scientific developments in production leads to the fact that the level of use of scientific achievements according to some estimates does not exceed 10% in agriculture. Seed producers ignore scientifically based recommendations on the placement of varieties. Contrary to the current legislation, varieties that are not included in the State Register of selection achievements of the regions of admission zones are widely used, the work on seed production have developed not in all entities.

For developing and implementing a program for selection of varieties (hybrids) of grain crops on the basis of scientific and academic organizations, it is necessary to provide for:
- sources of financing as state as private;
- formation and introduction of information-analytic system of efficient monitoring and assessment of condition of scientific-technological provision of researches in the field of selection technologies including technologies of genetic modification as well as risks of uncontrolled spreading and use of these technologies;
- development of special laboratories and centers implementing researches in the field of genetic technologies and their technological provision as well as training of personnel in this field (Nechaev, Gaponenko, 2013);
- laboratory and sorted control of grain crops as a basis of grain business creation in Russia (Lyubimova, Eremin, 2018);
- using the experience of Brazil (De Urzedo et al., 2019) to provide for measures of state support directed to preservation and active use of Russian genetic resources in plant selection and to decrease the dependence of domestic agricultural production from import of seed and planting material.

In addition, one of the promising directions in selection and seed production of grain crops is digitalization. The elements of the process of agro-digitization include: zoning of the region for the purpose of ecological testing of varieties and hybrids of grain crops, simulation of the reaction of source material to natural and climatic conditions of the region and most importantly - will track the path of seeds from an originator of the variety to a final user.

The next barrier in the implementation of digitalization of selection and seed production of grain crops is a limited ability of the country's selection centers to purchase modern machinery with special equipment. So, if in the USA the share of such equipment is as follows: tractors - 25,9%, combine harvesters -17,9%, these rates do not exceed 2,0 and 1,6 % in the Russian Federation respectively (Nekrasov, 2019).

We have high hopes for improving the mechanism of grain seed market management with the Federal State Information System in the field of seed production of agricultural crops (hereinafter, FSIS Seed Production). As a change in its structure, we proposed a scheme, which is presented in Figure 4.

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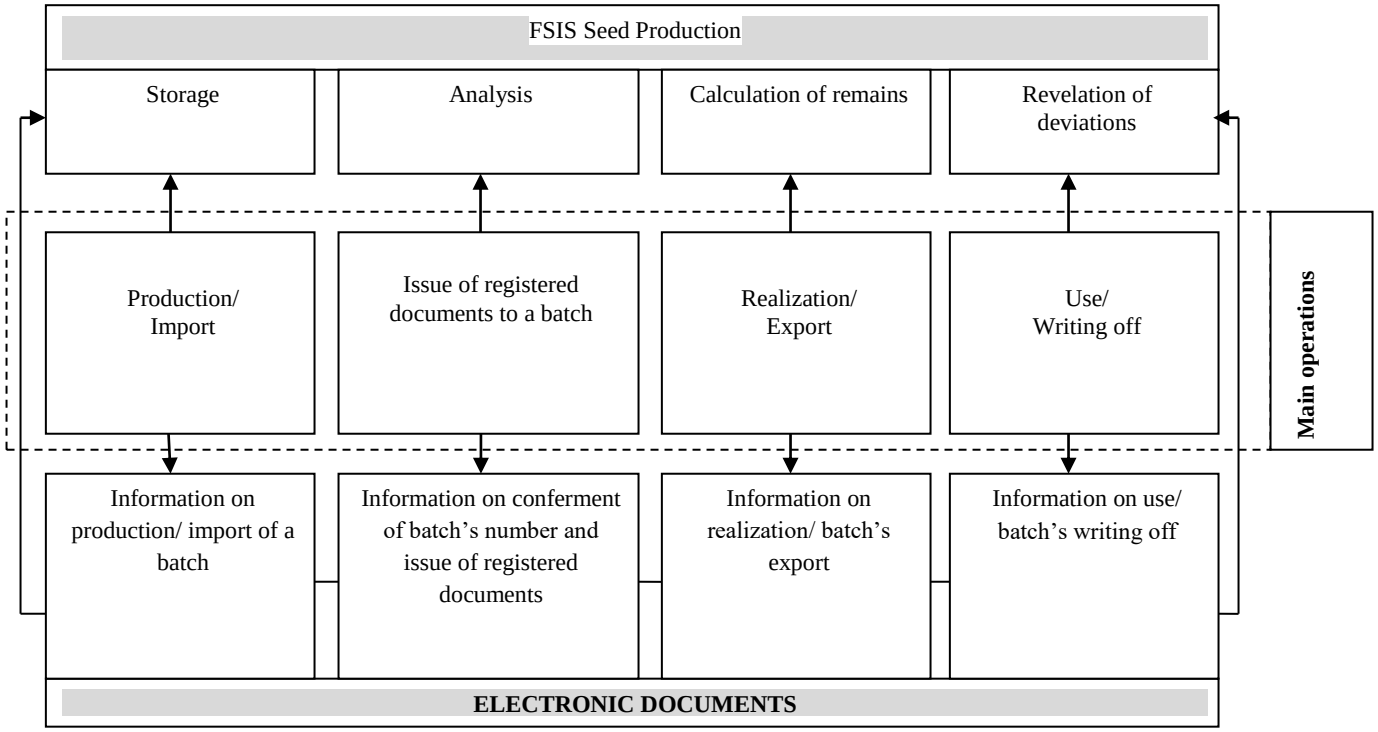

Fig. 4. Proposals for the formation of the Federal State Information System in the field of seed production of agricultural plants
Source: compiled by the authors based on (Nekrasov, 2019)

We have proposed a new organizational mechanism of the federal state information system, which includes an algorithm of management actions in the production, storage and sale of agricultural seeds with a set of relevant documents based on agro-digitization. This approach allows us to take into account the zoning of regions, the classification of agricultural organizations by the level of production and, most importantly, to determine the origin of a particular batch of seeds of any agricultural crop.

Conclusions

To solve the above problems, it is necessary to take the following measures to improve the selection and seed complex of grain production in the Russian Federation:
- creation of fundamentally new varieties and hybrids, increasing the efficiency of crop production in the regions of the country, as well as the application of the principles of agro-economic zoning of varieties and hybrids;
- increase of efficiency of use of domestic selection achievements, including modern biotechnological designs;
- development of scientifically grounded schemes of seed production, modern technologies of production of original, elite and reproduction seeds in practice;
- reduction of import volumes due to production of domestic high-quality varietal seeds;
- technological modernization of the crop industry, improvement of the material and technical base of breeding and seed production. It is necessary to purchase modern equipment for researches, high-quality agricultural machinery for the needs of selection and seed production;
- training of plant breeders and seed growers with mandatory socio-economic conditions for scientific staff, including housing, sufficient wages to attract young talented specialists to work in this sub-sector of agriculture. To do this, it is necessary to work with target universities, to form basic departments together with agricultural

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research centers for further passage of practical training of students on the basis of these centers, to train specialists through postgraduate school. It is necessary to train highly qualified specialists for researches in the field of marker selection, protection and physiology of plants and other agricultural areas;
- cooperation with leading foreign scientific centers, as it allows to use unique scientific installations and instrument-methodical base, to master advanced technologies;
- to recognize agricultural research centers as agricultural producers, according to Federal law No. 424-FL from 28.12.2017 (Federal law 2017).

The proposed measures to improve the system of state regulation of selection and seed production of grain crops in the country will contribute to the increase in exports of grain and products of its processing, technical and technological modernization of the sub-sector of crop production.

They will complement the priorities set out in the "Long-term strategy for the development of the grain complex of the Russian Federation until 2035" (Long-term strategy 2019) and the Federal scientific and technical program for the development of agriculture for 2017-2025.

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