

The role of breeding centers and breed testing systems in the development of breeds with a wide potential for use

A. L. Zolkin^{1*}, *E. V. Matvienko*², and *L. A. Pankratova*³

¹Povolzhskiy State University of Telecommunications and Informatics, Computer and Information Sciences Department, 443010 Samara, Russia

²Volga NIIS - branch of the Samara Scientific Center of the Russian Academy of Sciences, Laboratory of Breeding and Seed Farming of Cereal and Sorghum Crops, 446442 Ust-Kinelskiy, Russia

³St. Petersburg State University, Physical Geography and Landscape Planning Department, 199178 St. Petersburg, Russia

Abstract. It shall be noted that the country's food security is impossible without modern breeding and seed production, which fully applies to both open and protected ground. Grain crops, wheat, barley, corn, rice and others, in terms of fodder productive qualities, are always among the most valuable agricultural crops and are the staple food in many countries of the world. The production of advanced agricultural products is carried out through the use of effective methods of genetics, breeding, seed production, diagnostics of pathogens, integrated plant protection products, the latest technologies and others. The tasks of breeding and seed production of agricultural crops are the reproduction of seeds of breeds and the maintenance of their genetic potential in order to preserve the properties and economically valuable traits. High-quality seeds of the best zoned breeds and hybrids are the foundation of the future harvest. Breeds with a wide adaptive potential allow them to be grown in different climatic conditions and to select for the best forms.

1 Introduction

Breeding and seed production of agricultural plants are the main part of adaptive crop production, and they play a decisive role in biologization and ecologization, intensification processes [1].

Under the adaptive breeding of agricultural plants can be understood as the creation of breeds and hybrids of plants that have a fairly high potential.

Such breeds, according to J. Atsia, can be called breeds of workers and compares them with breeds of champions. There is an adaptive potential, at which the limit of resistance in cultivated plants to a stress factor (unfavorable) is set - cold, drought, soil salinization, weediness of crops, diseases and pests. Breeding is working in the direction of increasing adaptive potential, and this is the main thing that was at the heart of "folk selection", when

* Corresponding author: alzolkin@list.ru

the task was not set to obtain high and record yields, but it was important to obtain breeds and hybrids resistant to adverse factors (climatic and pathogens).

2 Problem statement

A. Zhuchenko describes the general conditions for cultivation technologies: productivity, energy efficiency, environmental friendliness and environmental protection [2].

The adaptability of a species (hybrid) is an aligned combination of a conditioned number of features, in which the most significant of them are given priority. The degree of adaptability of a breed or hybrid depends not so much on its adaptability, but also on the nature of the environmental conditions that are organized in the agrocenosis.

The following requirements are imposed on an adaptive variety:

- natural plasticity, in other words, the ability to produce an excellent harvest, at least an average one, in a wide range of weather conditions;
- heterogeneity of agropopulations, or existence in their composition of plants that differ in height, depth of the location of the root system, stability to the dry period;
- timing of flowering;
- precocity, the ability to consume and quickly produce and outpace weeds in the pace of development;
- intensity, in other words, the ability to rapidly respond to the improvement of growing places (to precipitation);
- resistance to fungal and other diseases;
- insignificant susceptibility to insects and high ability to grow back when attacked [2].

3 Research questions

An example of such an adaptive breed is the winter rye variety, which was bred by the Bashkir breeder S.A. Kunakbaev. It forms a fine and continuous herbage, withstands competition with weeds, is resistant to pests, can produce new shoots due to regrowth when damaged, and also gives high yields in critical periods (dry periods) in years when spring and autumn rainfall is effectively used. Breed is one of the most important factors that determines the level of crop yields, the most inexpensive and affordable means to increase it. In the world, according to literary sources, about 30-50% of the yield increase can belong to a new variety, within 50-70%, the share of the breed as a crop formation belongs to Russia. This is due to the fact that a huge part of the terrain (territory), agriculture takes place in poor or unfavorable conditions, and there are quite extreme soil and climatic conditions.

4 Materials and methods

Purpose of research is to study the breed testing system in Russia and assess the breed as an adaptive system with a wide potential for use in various soil and climatic conditions.

With worse soil-climatic and weather conditions, and with lower the level of technical equipment and subsidization of enterprises the higher the role of the variety is. The genetic characteristics of the breed and their impact on the yield are within 25%.

According to T.V. Borisovets (2000) the role of the genotype in increasing and stabilizing the yield also increases the role of the breed in zoning up to 30 ... 50%. One of the most important elements that ensure that the required amount of good quality products received is to treat the breed as an element of agricultural production [3].

The main and important requirement for the breed is a high yield. A new breed can become widespread in production, provided that high and stable yields are obtained (the best

yield out of the existing breeds of this crop) [4]. The breed must have ecological plasticity, maintain a consistently high yield in different natural and climatic zones of our country.

5 Results

With regard to modern unique breeds, care must be taken to ensure that they are perfectly adapted to the basic conditions associated with the use of various mechanisms in agriculture. Special machines and equipment are used here, designed both for care and for sowing and harvesting. When it comes to agricultural crops, first of all, they pay attention to high quality. This trait is considered as one of the most basic and popular. In this case, it is important to clarify the value of the plant by the presence of various nutrients, useful elements. The composition of the product affects the taste, the possibility of long-term storage and transportation. When it comes to quality, you need to pay attention to the basic rules of the entire complex for processing products. Special plant breeds (cereals) that are unique in their features and characteristics are required. First of all, attention shall be paid to specific traits related to the food industry, as well as to the manufacture of various desserts and bakery products.

An important role is played by the high-quality, well organized development of special agricultural technology for various breeds and hybrids, which differ in the main features of adaptation to those environmental conditions that are changing. The quality of these crops is associated with the level of agricultural technology. It affects this kind of situation if the most intensive breeds have low yields when compared with local breeds under adverse conditions, both climatic and weather. In addition, we are talking about the use of various kinds of high-quality fertilizers and means that fight weeds [5,10,11]. You can pay attention to the main document that describes the features of agricultural devices - this is a special passport. In it you can find a lot of relevant information about the characteristics of various reactions of cultures. Also in the center of attention are the main options for its high-quality cultivation in a particular climate and soil. You can focus on assessing the adaptive responses that are offered to the cultivation of different crops in individual specific areas and territories. Here it always shall be focused on the creation and application of an agroecological passport. There is a specific passport of a specific variety, which is issued after performing various tests. But this shall be taken into account when assessing the variability of characteristics that will determine the main characteristics of breeds of a particular type of crop in relation to environmental factors.

6 Findings

Attention will need to be drawn to the important role of the main breeding centres, as well as to a dedicated separate system for testing different breeds. In this case, the main role is played by the principle of adequacy. Here we are talking about the creation of a modern individual breed at the time of its creation in accordance with the characteristics of its production. Exclusively scientifically based approach to the process of choosing the different breeds shall be always considered. In this case, in the first place is the reserve for increasing the level of intensity in crop production [5,12]. Talking directly about modern breeds, then it shall be noted that they shall have excellent adaptability to specific conditions, territories, resistance to various existing environmental factors. Attention can be paid to agroecotype breeds. They are highly adaptable to various conditions.

The attention is drawn to the fact that a careful analysis of specific breeds is considered as an objective one, but for specific conditions and features of their cultivation. Various changes take place, some of them involve changes in the levels of specific factors in a certain

direction, which can often lead to a process of changing the rank of a variety. Also the variability of quantitative indicators is in the focus which is associated with the conditions and circumstances of cultivation. Also there is a focus on a special interaction where there is an environment and a genotype. Some testing of breeds, hybrids, etc. can be done. In fact in the future there are some significant changes that turn out to be key. For example, there is a drop in the indicator of resistance to unregulated environmental factors. The main goal of the professional is to find the best genotypes. But he can know about them only from external data that are created and manifested in specific conditions. It is important to cope with the problem of creation of conditions in breed testing. Here, it is easy to identify specific genotypes of interest.

Also the breed testing (state) is in the center of attention. It represents the unity of environments for the correct assessment of genotypes. This makes it possible to obtain accurate data on the adaptability of breeds.

It is also important to pay attention to the main goal of increasing the efficiency of selection (adaptive). Here it is important to focus on creating a special system for testing breeds, they would analyze and take into account the various conditions of specific areas of agricultural production. As an example, one can clarify the point of view of L.P. Kosyanenko, he talks about the factors that are associated with the yield of oat crops. He also drew attention to the possibility of realizing its effectiveness and quality in the Siberian region.

The yield index was correlated with the growing area by sixty percent. You can also notice a small contribution of such a factor as breed. The analyzed genotypes are really similar to each other in terms of efficiency. It is for this reason that obtaining yields is associated with the area of growth. There is a GSI system that needs constant change. Without breeding centers it is impossible to achieve better indicators and results. The focus is on the modern Breeding Center located in Moscow. There is a center that is engaged in research, analysis and detailed study of all major cultures and so on of the two countries. These are the Russian Federation, as well as Belarus [6]. Also, it is due to a special network in the field of breeding that it is important to pay attention to the process of obtaining different breeds when growing not one, but several generations of crops in one year. It is also important to note the specific area where they grow. An excellent indicator of technological support is an important element of a modern network. In this case, the focus is on a whole complex of different information centers, modern greenhouses, and so on [6]. In all organizations for growing and obtaining crops, there shall be everything you need to work. Various modern and original equipment, devices, worthy equipment are noted. In order to create some breeds of crops in the temperate zone, a few years ago it took more than ten years. But at present, such terms are actually quite long and lengthy, this shall not be allowed. You can pay attention to the opinion of N.I. Vavilov, who at the very beginning of the twentieth century noted the importance of accelerating the speed of growing crops through the interaction of hybrids in winter. In numerous breeding centers of the country there are special phytotrons. They make it possible to obtain several generations of crops in one year. And it helps to speed up the development process. It shall not be forgotten that it is precisely the possibility and necessity of accelerating the development process that is considered as the main feature of the work of breeding companies in different countries. A good example can be given. A company in America has created a large greenhouse out of California, and crops are constantly carried out in it and the most original lines are selected. In addition, California can be used to spread different breeds that make it possible to receive a new crop in winter. So modern breeds with specific features can be easily and quickly get. They can meet the needs of agricultural producers. It is also important to constantly pay attention to the productivity of plants. This makes it possible to get a high yield and find the main ways to control the quality of goods. Favorable combinations of different factors in terms of the impact on the yield have been

determined. Also the main indicators of plant development, growth and other features are in the focus of attention [7].

7 Discussion

During the use of hermetic phytotrons, where it is possible to detect the main conditions of different zones, a careful study of environmental factors is carried out, also the focus is on fertilizers that affect the processes of growth and development of plants. The creation of different conditions (climate) makes it possible to understand the possible productivity of crops under certain environmental conditions. This makes it possible to identify directions for changing the technology of the process of growing cultivated plants and increasing the quality of fertilizers in specific conditions. Of course, during the cultivation of various crops, additional costs will be required. This affects breed testing. First of all, a rich choice of microzones, as well as a rather slow decrease in errors during an increase in the breed testing time. All this suggests that it is almost impossible to achieve an increase in the quality assessments of breed testing [7,13,14]. It shall be noted that a particular type of cultivated crop is distinguished by a whole set of potential characteristics for adaptation. It is for this reason that the layout of breed testing zones for different plants is also different. It often happens that the gap in plant yields in production is closely associated only with the fact that agrotechnical rules are not observed. But it shall be noted that great importance is attached to the creation of a common network of plots for breed testing. During the (state) breed testing, the best breeds, as well as hybrids, begin to differ in certain characteristics, advantages and features. This method is effective in evaluating various breeds that are close to the usual ones in terms of features. When it comes to testing breeds that differ in many ways from the usual ones, there can be quite relevant and useful examples among low-quality breeds. It shall be noted that within a particular climatic zone there is a significant variability in the features of the microclimate. The focus is on such parameters as heat supply and possible frosts. In addition, if the actual conditions in which the breeding center is located are not typical in terms of soil type, topography, then the number of real recommendations is small. Then it can be noted that specific plant breeds will be adapted to a specific field niche. While trying to transfer the received data to a large area, they will lead to significant errors [7].

The biological system and the role of the breed in obtaining stable high yields is important in various soil-climatic and in the diversity and economic conditions of (agricultural) production (Table 1).

Table 1. Parameters of the contribution of factors to the formation of crop yields [4].

Groups by importance	Factors	Contribution limits, %
Dominant influence	Weather conditions	10-70
	Fertilizers	30-50
	Soil	20-40
	Plant protection	10-50
Moderate impact	Variety	10-15
	Crop rotation	5-16
	Relief	2-50
Unsustainable impact	The ratio with. - x. land	2-5
	Tillage	0-10

Quite high requirements are imposed on breeds. And first of all the resistance to various environmental factors shall be mentioned. They are associated with the formation of productivity. This situation is important for those places where there is a sharp emergence of

unfavorable climate opportunities for crops. The ability to study, assess the plasticity of breeds, as well as the area of their use, adaptation to climatic conditions - all this is considered the main issue in the production of various types of (agricultural) products.

As for adaptive breeding, it is associated with the resistance of a culture to various environmental factors. She has major special characteristics. First of all, the focus is on the regional significance, the possibility of taking into account real productivity [8,9]. All this indicates a modern strategy for selecting backgrounds at different stages of breeding. The focus is on the actual estimation of the background parameter. This is about typicality, productivity.

In addition, a constant and fairly strict control over external conditions, carried out in accordance with all the points and rules, is carried out for the correct selection through the use of special breeds that are testers. A special selection is carried out for stability, productivity at different stages of plant cultivation. Also, the focus is on the creation of various methods for competent assessment of the adaptive capacity, stability of various elements to obtain breeds with different characteristics. But this is not all, it will be necessary to focus on the various breeding schemes presented, they just evaluate stability. Various crop growing organizations face great challenges in creating modern and unique ways to create breeds. Also in the center of attention are special multi-line mixtures, constant selection. At that time, it is necessary to pay attention to the possibility of moving material in one region.

8 Conclusion

Breeding is faced with the main task associated with a combination of excellent yield and resistance to stress. But in this case, the factors of external conditions can be really strong and quite serious. This is due to the fact that the ways that affect the development of crops lead to a change in their high resistance to stressful situations.

All major environmental stresses shall lead to a slow process of growth and development. Organs of plant generation are not fully protected from negative stressful situations. It is for this reason that special breeding programs that are associated with the desire to increase the resistance of a breed to negative factors shall be looked at with special attention. The focus is on the ability of breeds to cope with the negative effects of various stresses. There are several main causes of this kind of problem. In modern times, indeed, there is a great distance between two moments. On the one hand, this is the expected yield, and on the other hand, the real one. Also in the focus of attention is the relationship of the selected fertilizers for permanent and often forage crops, as well as the quantity and quality of the future crop. Weather conditions also play an important role in obtaining a good, quality and planned harvest. There are times when severe droughts or rains occur, which negatively affect the receipt of a high yield in all respects.

References

1. A. V. Kilchevsky, O. G. Babak, N. A. Nekrashevich, B. F. Adzhieva, C. V. Malyshev, Z. F. Grushetskaya, L. A. Mishin, M. M. Dobrodkin, I. E. Zaitseva, I. G. Pugacheva, *Molecular technologies in tomato (*Solanum lycopersicum* L.) breeding. Genetic bases of plant breeding* (Belarusian Science, Minsk, 2014)
2. A. A. Zhuchenko, *Resource potential of grain production in Russia (theory and practice)* (Agrorus, Moscow, 2004)
3. T. Borisovets, *Agroeconomics* **3**, 30–32 (2000)
4. G. I. Bazdyrev, A. V. Zakharenko, V. G. Loshakov, A. Ya. Rassadin, A. F. Safonov, A. M. Tulikov, *Agriculture* (Koloss, Moscow, 2008)

5. I. N. Volkova, “Genetic engineering, breeding and seed production as an innovative activity in the agrarian sector of Russia: problems and development prospects”, in *Innovations in territorial development: materials of XXXVI Annual session of economic and geographical sections of the International academy for regional development and cooperation (IARDC)* (2020), pp. 87–97
6. O. S. Korzun, A. S. Bruilo, *Adaptive features of breeding and seed production of agricultural plants: textbook* (GSAU, Grodno, 2011)
7. V. A. Dragavtsev, *On the problem of genetic analysis of polygenic quantitative traits of plants* (VIR, St. Petersburg, 2003)
8. A. V. Kilchevsky, L. V. Khotyleva, *Genotype and environment in plant breeding* (Science and technology, Minsk, 1989)
9. A. V. Kilchevsky, L. V. Khotyleva, *Ecological plant breeding* (Technology, Minsk, 1997)
10. N. V. Zakharchenko, S. L. Hasanov, A. V. Yumashev, O. I. Admakin, S. A. Lintser, M. I. Antipina, *Journal of Environmental Management and Tourism* **9(3)**, 510-523 (2018)
11. T. A. Lachinina, M. S. Chistyakov, *Economic revival of Russia* **2(68)**, 130-145 (2021)
12. A. L. Zolkin, E. F. Amirova, B. S. Strigin, A. M. Kuzmin, S. V. Shamina, IOP Conference Series: Earth and Environmental Science. International Scientific and Practical Conference "Environmental Problems of Food Security", 012035 (2022)
13. E. V. Matvienko, A. L. Zolkin, D. K. Suchkov, L. A. Pankratova, IOP Conference Series: Earth and Environmental Science. "International Science and Technology Conference "Earth Science" (ISTC EarthScience 2022), 042065 (2022)
14. V. Zhukovskyy, S. Shatnyi, N. Zhukovska, A. Sverstiuk, “Neural Network Clustering Technology for Cartographic Images Recognition,” in *IEEE EUROCON 2021 - 19th International Conference on Smart Technologies* (Lviv, Ukraine, 2021), pp. 125–128.