Use of a new breeding methods for creation of breeds with desired properties and traits

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Abstract. In modern crop production (including field, vegetable, fruit and berry, ornamental and even some forest crops), breeds are cultivated. All of them are the products of breeding (the branch of agricultural production). According to various sources, selection currently provides from 25 to 40% of the increase in yield, the rest falls on the share of cultivation technology. There are examples of a more significant contribution of breeding to yield growth. Breeding is available for such changes in the quality of products that are beyond the power of agricultural technology, for example, the color range of flowers of ornamental crops, the composition of oil in oilseeds, improving the baking qualities of flour in wheat, and increasing the content of substances with medicinal properties in medicinal plants.

1 Introduction

Selection of the best forms from natural or cultivated plants was the only method of breeding in the past. Therefore, initially this concept was fully consistent with the content of the work on breeding new breeds. Over time, it has become wider. Modern breeding uses selection, using methods of artificial creation of starting material (hybridization, mutagenesis), various methods of growing selected plants and a number of special techniques. However, selection remains the only way to develop new breeds. Breeding is the doctrine of selection in the broadest sense of the word. It includes the selection of source material, the process of variability and heredity, the selection and creation of new forms. Plant breeding is inextricably linked with seed production. The basis of breeding and seed production is the doctrine of heredity and variability of organisms - genetics. Academician N.I. Vavilov wrote that breeding can be considered as a science, as an art, and as a certain branch of agricultural production [1,2].

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2 Problem statement

An important and urgent problem in plant breeding is the task of creating breeding material with desired properties. The creation of such material is still a complex and, in some cases, difficult task. On the one hand, with the advent of genetic engineering technologies, it became possible to create such plants. However, the imperfection of these technologies and the possibility of genetic modification of only single traits does not always allow them to be applied in practice. On the other hand, classical breeding methods have created a huge amount of valuable breeding material. The use and integration of new technologies for the molecular genetic evaluation of this material in the breeding process will significantly reduce the time for creating genotypes with desired properties.

Over the past two decades, the use of molecular genetic methods has made it possible to study the physical and functional organization of the genomes of many agricultural crops.

3 Research questions

Purpose of research - to evaluate new modern methods in breeding to create breeds with desired properties and characteristics.

Modern plant breeding uses a whole range of methods based on the latest achievements of many biological sciences. The importance of biotechnological methods in plant breeding is great. With the help of innovative approaches, the following breeding tasks are solved: creation of a new source material; acceleration of the breeding process; reducing the labor intensity of breeding work. In addition, the successful development of crop production depends on rapid variety change, variety renewal and sustainable seed production [3, 12, 13].

4 Materials and methods

It shall be noted that it is impossible to carry out breeding work at a decent, high level without modern integrated mechanization associated with elite seed production. Today, the focus is on unique innovative technologies, automation issues in this area. The specific Decree of the President of the Russian Federation No. 350 dated 21 refers to the creation of a whole range of various methods, techniques, and measures that are aimed at the modern technologies introduction. They ensure the production of quality seeds of crops in various areas of our growing plants [4].

5 Results

Modern molecular marking technologies significantly increase the efficiency of selection and breeding process, which can be used to identify donors of agronomically important traits, mark genes for resistance to diseases and other biotic and abiotic factors, identify breeds, etc.

In addition, the selection of various crops takes into account the possibility and necessity of studying various ways of creation and change of the features of plant breeds with basic parameters [5]. The basic breeding methods shall be considered. Numerous breeds of different plants are created from the presented breeds through the process of constant collection of the highest quality crops. The initial population, which is selected as the best breed, has been selected. And then the best examples and samples are selected and multiplied and unique breeds are received. The method described above is called analytical breeding. Here the focus is on the analysis of lines. The population consists of these lines [6].

Specifically the breeding that was mentioned above is the beginning of the creation of scientific breeding at a high level. Many different breeds of populations which man has

created over the entire period of his existence have been used here. And this technique has become popular and relevant [7].

Recently, the arsenal of breeding methods has been significantly replenished due to breakthrough achievements in the field of genetics, genomics, and biotechnology, defining the main priorities of modern plant breeding and expanding the ways to achieve them (Table 1).

Table 1. The main priorities of modern plant breeding [11].

Priorities	Ways to achieve
I. Expansion of the spectrum of genetic variability	Creation and use of genebanks; mutagenesis; recombinogenesis; transgenesis
II. Improving selection efficiency	Selection using molecular markers; ecological organization of the selection process
III. Increasing the information content of the selection process	Genetic-statistical methods; information technology, selection computerization
IV. Reducing the time for creating varieties and hybrids	Use of phytotrons; biotechnological methods (haploidy, clonal micropropagation of valuable genotypes)

6 Findings

Improving the efficiency of breeding. The methods of genotypes selection used in breeding are very diverse and depend on the biology of plant reproduction, trait inheritance, hybrid generation, environmental conditions, and other factors. The most important condition for effective breeding is the exact identification of the genotype by the phenotype. In the case when it is talked about qualitative traits (for the inheritance of which 1-2 genes are responsible) the breeding is relatively simple. However, most economically valuable traits are quantitative, and their formation depends on the environment; in this case, the value of the genotype can only be determined as the average value of all phenotypes under changing conditions [9,10].

Most beneficial mutations under the influence of artificial mutagens occur in breeds of hybrid origin, but in order to become breeds the obtained mutant forms of plants in the most cases shall be crossed again [8].

It is quite obvious that DNA-certification takes breed testing and seed production to a fundamentally new level.

Increasing the information content of the breeding process. The most important tool for increasing the efficiency of the breeding process is informatization. Genetic and statistical methods were formed at the intersection of a number of sciences such as biometrics, genetics, selection. The Institute of Genetics and Cytology made a significant contribution to their development. Methods for assessment of combinational ability in breeding for heterosis, as well as adaptive ability for increasing the adaptive potential have been developed and improved. Also RISHON and ABSTAT application packages for statistical analysis of the results of breeding and genetic experiments have been developed and improved. Their use greatly facilitates the work of scientists. Creation of an automated workstation (AWS) of a breeder (a software package based on modern information technologies) is the immediate task [9,11,14,15,16].

7 Discussion

The intensification of crop production has led to a rapid breed change. The life expectancy of a breed is constantly decreasing, and the breeder must instantly respond to the challenges of the time, using all the possibilities to speed up the breeding process. Among the methods

that make it possible to reduce the time for creation of a breed there are heterosis and gamete selection, the use of culture in vitro , application of phytotrons and molecular markers, selection based on haploids . Selection for heterosis makes it possible to combine a complex of desired genes in a hybrid genotype, which is not always possible while breeding of constant breeds. Selection based on haploids allows to carry out quick homozygotization of the hybrid material, achieving its evenness, which makes it possible to reduce the duration of the breeding process by 3-4 years and reduce the cost of breeding of new breeds. An important reserve for acceleration of breading and increasing its efficiency is the gamete line of research [9,10,11].

8 Conclusion

In general, it shall be noted that traditional breeding in recent years has been significantly supplemented by methods of biotechnology, genetics, ecology, and computer science. Does this mean that traditional selection will be replaced by selection in test tubes and phytotrons? Of course not. However, the use of modern genetic and biotechnological approaches creates fundamentally new opportunities. Evidence of this is the widespread use of heterotic hybrids in protected ground and field conditions, the expansion of sowing of transgenic crops, new crops (triticale) obtained by separated hybridization. Breeding success today is the result of a creative union of breeders with geneticists, biotechnologists, phytopathologists, physiologists, ecologists, mathematicians and representatives of other specialties.

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