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The impact of research and innovation results on the development of agriculture in the Republic of Moldova

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THE IMPACT OF RESEARCH AND INNOVATION RESULTS ON THE DEVELOPMENT OF AGRICULTURE IN THE REPUBLIC OF MOLDOVA

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Abstract: *The results of the activity of the research/development sphere in the Republic of Moldova play an important role in dynamism of the sustainable development of the basic branches of the national economy: agriculture and the food industry. They contribute essentially to providing the country with agricultural raw materials and industrial processing products, sufficient for the needs of the domestic market and for export. Food security and food safety are closely related to the results of technological transfer of research and innovation results in the fields of agro biology and the food industry. The innovative cluster in these sectors of the economy of the Republic of Moldova consists of 9 biological institutes, 6 agricultural institutes and the State Agricultural University of Moldova. The present study also includes some issues of the impact of climate change and the decline of biodiversity, other challenges and risks to the development of agriculture and related branches of the country's economy.*

Keywords: *agricultural science, food security, innovation cluster, agro biology*

JEL classification: Q00

INTRODUCTION

Agriculture and the food industry are the basis of the development of the economy of the Republic of Moldova, taking into account that its specificity is agro-industrial. Approximately, out of 2 mln. ha of arable land, the share of the most productive areas, such as fruit growing, viticulture and vegetable growing, does not exceed 15%. The fields are occupied with cereal crops, sunflowers, soybeans, sugar beets, which provide the processing industry with agricultural raw materials and their export (Report ASM 2021).

Technical-scientific assistance in the country is provided by 6 research institutions and the teaching-professional staff of the State Agricultural University of Moldova. At the same time, 9 biological profile institutes realize their scientific potential, which carry out research in the fields of physiology, genetics, microbiology, ecology, forestry, etc. In total, in the sphere of research and innovation in the Republic of Moldova, there are approx. 500 researchers, specialists in the respective fields. Based on the results obtained, agro biological science makes an important contribution to food security and food safety in the country (Activity report, 2021).

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MATERIALS AND METHODS

The systemic analysis of the results of agrobiological research, reformed in 2018 by the amendments to the Code regarding research and innovation in the Republic of Moldova, attests to the important role of implementations in the national economy. The work "Trends in the economy of Moldova", edited annually by the National Institute of Economic Research, was consulted. The results included in the Report on the state of science in the Republic of Moldova, as well as the National Development Strategy "Moldova 2030", were also systematized (NDS "Moldova 2030", 2022).

The most relevant achievements of agro biological research in Moldova belong to the fields of horticulture; new varieties of vines (table, mixed and for industrial processing) were obtained, they are the result of over 10 years of work at the Institute of Genetics, Physiology and Plant Protection.

Eight new interspecific rhizogenic varieties, obtained for the first time by crossing *Vitis vinifera* L.V x *Muscadinia rotundiflora* Michx: Alexandrina, Augustina, Nistreana, Malena, Ametist, Algumax, Tethys and Sarmis were approved and included in the State Register of Plants of the Republic of Moldova. Possessing appreciated uvological qualities, these varieties are included in the context of elaborations related to global warming, being resistant to diseases and pests, they will form the basis of ecological viticulture (Sturza R., 2021).

The Scientific-Practical Institute for Horticulture and Food Industry implemented the Moldova grape variety on an area of approx. 10 thousand. ha, allowing the export of fresh product to Romania, the Czech Republic, Poland, Ukraine, Russia, Belarus and Kazakhstan. Researchers and businessmen say that the Republic of Moldova also became known thanks to the Moldova variety, which is placed among the most successful grape varieties with a red-purple color. The Italian concern Vivai Cooperativi Rauscedo, through an agreement with the Institute of Horticulture from Moldova, undertook to devirose the varieties Moldova, Codreanca, Moldavian Kişmiş and others, and to sale them in the states of Europe and North Africa. Royalty for the originating institute is about 50 thousand euros annually, plus sanitized and certified material.

The hybrids of the "Porumbreni" Institute of Phytotechnology entered the top 10 performers at the competitions held in Ialomița - Romania; the variety "Porumbeni 374" ensured a harvest of 19 tons of berries per 1 ha with their humidity of about 9%. Thanks to this performance, Romania supports the homologation of high-performance hybrids from Moldova in the space of the European Union states.

Approximately, 50,000 ha occupied in the Republic of Moldova with the cultivation of soybeans, approximately 40-45% of the areas are sown with the varieties of the "Selection" Field Crops Institute. Important areas are occupied with leguminous crops in the country also obtained and implemented by this well-known institute (peas, beans, etc.).

The fight against erosion, desertification and solanization of varieties in the country is based on the elaborations of the Institute of Pedology and Agrichemistry, obtained through collaboration with fellow researchers from Romania (ASAS) and Ukraine (ANSAU).

The collaboration of researchers from the Scientific-Practical Institute for Biotechnology in Animal Husbandry and Veterinary Medicine with colleagues from Romania, France and Italy allowed the testing and implementation of alpine goats in the conditions of the South and Central areas of the Republic of Moldova with an expected effect on the production of milk and derivatives from it, as well as the meat. The staff of the institute in collaboration with the Botanic Garden (Institute) in Chisinau have carried out important studies related to the provision of animal feed, premixes,

vegetable proteins and other by-products to the animal husbandry sector: pressed pulp from fruits, vegetables and grapes, seeds and tomato.

The National Center "Acvagenresurse" through the high results obtained in the selection of the new varieties of Carp (silver and with large scales), provides through technological transfer 100% of fish fry for Moldovan fish farming.

The researchers of this important center for the national economy of the Republic of Moldova (the country is provided with practically 100% of fresh fish consumption) have been collaborating for several years with scientists from Hungary and the Russian Federation.

Although the agricultural machinery in Moldova comes from producers in the countries of the European Union, nevertheless in some positions the Institute of Agricultural Technology "Mecagro" develops and executes various machines for spraying vineyards and orchards, vegetables, foliar fertilization installations of agricultural crops, machines for grinding grain for animal feed etc.

Sprinklers were exported to Iran and Azerbaijan, and mini grain mills found their supply in Kazakhstan and other republics of Central Asian.

The State University of Agricultural Sciences of Moldova, led for 21 years by academician Gheorghe Cimpoies, has implemented multiple innovative technologies for apple, plum, cherry and sea buckthorn, the production of which is widely exported to Russia, Ukraine, Belarus and also to some EU states (Romania, the Baltic countries, etc.).

The Life Sciences Section (Agrobiology, Environment, Food Security) coordinated the scientific and innovative activity in the fields of agriculture, biology, ecology and the environment, regarding the realization of several projects. Among which: 2 research projects from the offer of research-innovation solutions regarding combating and mitigating the impact of the COVID-19 pandemic completed in 2021 and 48 projects from the State Program (2020-2023). This program includes the following projects: Strategic Priority Sustainable agriculture, food security and food safety - 26 projects, Strategic Priority "Environment and climate change" - 21, Priority Economic competitiveness and innovative technologies - 2; bilateral projects-3; project within the Horizon 2020-1 program; technology transfer projects-5 from 16 organizations in the field of research and innovation. The public hearing of the final scientific reports presented by the project leaders during the General Assembly of the Life Sciences Section from November 1-10, 2021 highlighted the fact that the scientific research planned for 2021 was carried out in the planned volume, in the established terms and at an appropriate methodical level.

The analysis of the state of security and food safety in the Republic of Moldova highlighted several vulnerabilities: insufficient domestic agricultural supply for a wide range of products, of which there are long-term deficits in meat, vegetables and fish; the instability of the internal agricultural supply, especially of vegetable production which indirectly affects animal production; high prices for some agricultural products; the low level of income of the population that generates food insecurity; inadequate road and sanitary infrastructure, especially in rural areas that generate food safety risks and nutritional insecurity; poor quality food consumption; the high share of calories from cereals and potatoes, as well as the low consumption of animal protein, which generates nutritional risks. There are population categories identified as having a high food and nutritional risk, including children, especially from rural areas.

Within the State Project 20.80009.5107.09 "*Improving the quality and safety of food through biotechnology and food engineering*" (2020-2023) which was carried out jointly by the Technical University of Moldova, the Institute of Genetics, Physiology and Plant Protection and the State University of Medicine and Farmacie "Nicolae Testemițanu", a study was carried out regarding the

nutritional status of institutionalized school-aged children (11-17 years old), based on the model menu proposed by the Ministry of Health.

The nutritional value of complex lunches for the 12 days examined was 2069 kcal/day, which represents 82.8% of the average daily requirement of 2500 kcal/day.

The average daily intake of iron determined by experimental techniques covers 53.75% of the recommended norm. An algorithm was designed to predict dietary iron absorption based on the content of dietary factors that have the ability to promote or inhibit iron absorption. It is also possible to mention the results that were obtained by the team of the technological transfer project 21.80015.5107.245T "Development and implementation on an industrial scale of the technology for the production of supplements of biologically active substances from native (oleaginous) raw material in the form of capsules ", carried out at the Scientific-Practical Institute of Horticulture and Food Technologies. Within the project, the technology for the production of supplements of biologically active substances from local raw materials was developed and implemented: white grape seeds, red grape seeds, pumpkin seeds, at the enterprise "Ulei Eco Grup" SRL. The innovative technology for processing agricultural production (grape seeds, pumpkin seeds) through CO₂-extraction and encapsulation of biologically active substances was implemented. Finally, the drafts of the technological documents (Technological Instruction and Company Standard) for the manufacture of SBA supplements in the form of gelatin capsules were developed. Thus, the nutritional value was ensured and the biological effects of food were amplified through biotechnology and food engineering (Sturza R., 2021).

In the context of these vulnerabilities, but also in the context of the international situation, with a series of uncertainties regarding the circulation of goods and the galloping increase in prices for fuel and basic food, it is necessary to establish the priorities for improving the food security of the population, which could be classified like this:

- because agricultural production is the main and safest source for ensuring food products for the population, the most important strategic direction is to increase the role of agriculture as a provider of food security, with the following objectives: increasing the level of ensuring the population's food consumption from domestic production, especially for important products (cereals, vegetables, fruits, meat, processed foods), stabilizing the domestic agricultural supply.
- another strategic direction is - increasing the population's access to food and improving the quality of food, which can be achieved by increasing the purchasing power of the population, reducing the gaps related to access to food for different categories of the population, improving the food diet and ensuring food diversity.
- the third strategic direction refers to rural development and raising the educational level of the rural population, as premises for improving food and nutritional security. The targeted objectives are related to the modernization of the infrastructure and the increase in the educational level of the population. In this context, the project "Improving national food safety systems and regional cooperation" was initiated, which was financed by the Government of Turkey and implemented by the Food and Agriculture Organization of the United Nations (FAO) (2021-2023). The project includes as beneficiaries five countries in the region - Azerbaijan, Kyrgyzstan, the Republic of Moldova, Tajikistan and Turkey and will support the National Agency for Food Safety (ANSA) by training employees in the field of analysis, evaluation, identification and communication of risks in the food field.

A valuable national heritage also presents the local forms of agricultural crops, cultivated over many decades in peasant households, where varieties with valuable traits of productivity, quality, resistance and interest for improvement have been selected.

The intensification of agricultural production, the use of highly productive varieties and hybrids have gradually replaced traditional varieties. Currently, the diversity of these varieties has decreased significantly, but some species have been saved. Thus, among leguminous crops, local bean varieties are distinguished by considerable variability. In a much smaller volume, chickpeas, sorghum, lentils and beans are grown. The diversity of local corn populations has drastically decreased, among the most well-known saved and cultivated forms being Moldovenesc, Gănganesc, Chiquantino, Orange, Lopusneac, etc. In particular, attention is paid to the glassy corn varieties used for the preparation of the national dishes - mămăliga. Currently, only some individual peasant households still grow such varieties of plants. Vegetable crops, represented by amateur varieties (that is, created by "amateur breeders"), or by selections (for 10-20 years) from commercial varieties that need to be preserved are: tomatoes, peppers, eggplants, onions, garlic, cucumber, squash, pumpkin, etc. In the small peasant households, the old varieties of fruit trees such as the apple with the old local varieties were still saved: Țiganka, Domnești, Lujanka, Golubok moldavskii, Mohorîta, Nestreț, Văratic dulce, Summer saffron, etc.; the plum with the old varieties Vinete de Codru, Bardace (several forms), Goldane, Vinete de Tiraspol, Perje Moldovenesti, Rotunda, Vinete de Vălcinet. A special interest for our country is the grapevine, the assortment of local varieties of which is less diversified. Thus the old varieties such as Coarna albă, Plavaie, Coarna neagră, Feteasca albă, Feteasca neagră, Codreanca, Busuioaca, etc. have a limited spread in poor households (Gaina B., 2021).

Increasingly frequent climate changes (drought, high temperatures) significantly affect natural systems. The most profound, direct and appreciable effects are reflected on cultivated species actively subjected to biological erosions. The continuous decline of biodiversity and the degradation of ecosystems reduce their capacity to function and may reach thresholds of irreversibility. The genetic diversity of cultivated plants is also strongly affected by the increased sensitivity to infectious diseases (fungal, viral), showing the increase in pathogenicity, in parallel with the increase in CO₂ concentration in the air and temperature, which influences *plant × pathogen × environment* interactions. Genetics and plant breeding have had a profound impact on food production and will continue to play an essential role in the creation of cultivated plant gene pools. Conservation and restoration of the plant gene pool is a major and cost-effective objective in mitigating the effects of climate change.

Based on the involvement of a valuable initial material as parental forms, new hybrids of common wheat, durum wheat, triticale, tomato were obtained. Genotypes with high indices of productivity and biochemical quality of grains, seeds, and fruits were identified in the gene pools of grassy cereal crops, legumes, and vegetables (tomatoes). In promising tomato varieties with high taste properties, including, with fruit pigmentation genes - β (carotene), r (yellow flesh), genotypes with valuable biochemical indices were registered: dry substance - 5.69-8.05% , sugar – 3.43-4.61%, acidity – 0.43-0.54, vitamin C – 22.06-30.0 mg%. Genotypes with high content of carotene (3.89 mg/100g) and lycopene (1.39 mg/100g), compounds showing high antioxidant properties, were highlighted. Four varieties of plants were approved for which certificates were obtained - common wheat (Moldova 66), durum wheat (Sofidurum, Auriu 2), chickpea (Cogâlnic) (Bulimaga C., 2021).

Based on the effective utilization of plant genetic resources and advanced biotechnologies, in order to increase the adaptability of crop plants to climate changes, hybrid combinations with increased resistance to biotic and abiotic factors were created. Three varieties of vines on their own roots have been approved and patented: Alumna, Amethyst and Bega, which, thanks to their interspecific origin, possess resistance to phylloxera and cryptogamic diseases, extreme low and high temperatures, which will allow obtaining competitive and ecological productions, as well as the extension of the cultivation limit in the northern zone of the republic. The Avantaj grain sorghum variety, which provides 6.5 t/ha, was sent to CSTSP. Two varieties of garlic, Berechet and Moldobella, were approved and patented.

CONCLUSIONS

The impact of climate change and the decline of biodiversity are two of the most important challenges and risks for human society. It is about biodiversity at the level of plants, animals and microorganisms, a fact that conditions the approach to climate change from these three aspects. The key practices for biodiversity in the conditions of climate change aim at the following moments:

- conservation of biodiversity;
- implementation of sustainable agricultural practices;
- responsible management of natural resources;
- involvement of the local community.

The conservation of the genetic diversity of agricultural crops is also a major concern for European countries and is dictated by the EU Strategy and the Action Plan through objective 3 - Maintaining genetic diversity through the conservation of crop plants, which emphasizes the need to improve the adaptive capacity of crop plants, building resilience and reducing vulnerability to climate change. At the international level, in order to urgently solve the problems generated by climate change, the Sustainable Development Objectives were developed, a fact previously mentioned. In this context, a series of objectives is implemented in the Republic of Moldova, among which is Objective 2. Updated data on indicator 2.5.1. of SDG 2 with reference to plant and animal genetic resources for food and agriculture conserved in the medium or long term, were prepared and exported to the international megadatabase. At the same time, within the Institute of Genetics, Physiology and Plant Protection, the Country Report for the 3rd World Report on the Status of Plant Genetic Resources for Food and Agriculture was developed. Based on the approach no. 24-07/184/1879 of 21.05.2021 of MADRM (currently MAIA), the National Report on the measures taken to achieve the commitments provided for in the International Treaty on Plant Genetic Resources for Food and Agriculture was drawn up.

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