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Megaproject on innovative transformation of the plant breeding system to increase productivity and yield (second half of the twentieth century)

***Abstract.** The purpose of the article is to reconstruct the events and analyze the scientific activities of the geneticist Oleksii Sozinov (1930–2018) aimed at the development of agricultural science in Ukraine. Particular attention is paid to the creation and development of the phytotron at the All-Union Breeding and Genetic Institute (now the Breeding and Genetic Institute – National Center for Seed and Variety Studies) in the second half of the twentieth century. The innovative transformation of the plant breeding system initiated by O. Sozinov, aimed at increasing the productivity and yield of agricultural crops, is studied. The use of methods of microhistory and comparative historical analysis allowed to reveal more deeply the scientific contribution of the scientist and his influence on the development of breeding science and technology. Based on the processing of archival materials, a set of sources was first introduced into scientific circulation, which allows us to rethink the importance of the developments of O. Sozinov and his colleagues in the creation and functioning of the phytotron. The analysis of documentary materials of the State Archives of Odesa Region and other sources allowed to expand the understanding of the use of phytotron technologies in breeding activities and their impact on agricultural science and crop yields. The contribution of O. Sozinov to the development of scientific research in the field of breeding and genetics, in particular the introduction of advanced experimental methods and the use of phytotron for research on grain crops, is outlined. It is proved that the scientist's many years of experience in plant breeding and genetics became the basis for the formation of long-term scientific directions in this field. The experimental approaches he introduced contributed to the innovative transformation of the breeding system, which ensured a significant increase in crop productivity and yield. It is concluded that the scientific achievements of O. Sozinov*



not only laid the foundation for further research, but also determined the prospects for the development of the industry for decades to come. The use of the phytotron has significantly expanded the possibilities of studying the influence of various factors on plant growth and development, which, in turn, has contributed to the creation of new highly productive varieties.

Keywords: *Oleksii Sozinov; plant breeding; phytotron; genetics; agricultural science; innovative transformation*

Introduction.

The development of agricultural science in the second half of the twentieth century was marked by an active search for innovative approaches to increasing the productivity and yield of crops (Strelko, Pylypchuk, O. Ya, & Pylypchuk, O. O., 2024). One of the key areas was the introduction of the latest breeding methods based on the use of controlled plant growing conditions. In this context, the megaproject of Academician Oleksii Sozinov (1930–2018), aimed at the innovative transformation of the breeding system using phytotronic technologies, deserves special attention.

Accelerating the crop breeding process remains one of the priorities of modern agricultural science. Artificial climate technologies play a decisive role in this, as they can significantly shorten the plant growing season and produce several harvests of grain and other crops during a calendar year.

Internationally, the development of phytotronic technologies began in the mid-twentieth century. In the United States and Europe, institutions such as the Beltsville Agricultural Research Center (USA) and the Max Planck Institute for Plant Breeding (Germany) pioneered the introduction of controlled environments for crop experiments. Research at these centers has shown that the use of phytotrons can reduce the breeding cycle from 10–12 years to 4–5 years, which has become a significant breakthrough in agricultural science.

Canadian and Japanese scientists also made a significant contribution to the development of the phytotron concept. In particular, in Canada, the National Research Institute of Agriculture has developed methods for precise control of the photoperiod to improve the growth of grain crops.

In the world scientific literature, the development of plant breeding technologies in the second half of the twentieth century is viewed through the prism of technological innovations, the use of controlled conditions for growing plants, and genetic methods of increasing yields. The phytotron as a breeding tool played a significant role in accelerating the development of new varieties of cereals, vegetables and industrial crops.

V. Dubovyi notes that research on the problem of studying the growth and development of cereal crops in an artificial climate has been going on for more than 40 years (Dubovyi, 2020). Analyzing the results of scientific works, especially those conducted in the period 1978–1990, it becomes obvious how accessible this engineering and biological method was. In particular, when the cost of 1 kWh of electricity was only 1 kopeck, the use of an artificial climate made it possible to significantly speed up the breeding process. This made it possible to obtain up to five

reproductions of spring wheat and barley, as well as three reproductions of winter cereals, which contributed to more efficient improvement of agricultural technologies and increased crop productivity (Downs, 1975).

Donald N. Duvick focuses his research on the use of controlled conditions for accelerated breeding and considers plant breeding using biotechnology primarily as a tool to improve the efficiency of traditional plant breeding, with a particular focus on increasing resistance to diseases and insects or adding new types of herbicide resistance. He notes that more and more attention is being paid to the potential of using biotechnology to create new industrial and food products based on plants (Duvick, 2009).

In his work, W. Gottschalk investigates the effect of temperature on flowering of *Pisum* plants using a phytotron. They studied 17 mutants and 20 recombinants under three temperature conditions. Low temperature (12.5 °C) significantly delayed flowering, but the genotypes differed from each other. High temperature (25 °C) had a negative effect on fasciate genotypes. None of the plants bloomed at either constant low or high temperatures - they need a change of low and high temperatures for normal flower formation. Studies confirm that most genotypes have specific temperature responses (Gottschalk, 1985).

J. Braak and L. Smeets provide a detailed description of the physiology laboratory, which includes a complex of greenhouses and specialized experimental rooms. The authors emphasize the conditions where researchers can control the main climatic parameters, including temperature and humidity, as well as regulate the duration and intensity of lighting, which allows them to create optimal conditions for scientific experiments. Special attention is paid to the technical aspects of microclimate control systems and their efficiency. The results of three years of experience in managing temperature and humidity conditions are summarized, which made it possible to assess their impact on the course of physiological processes in plants (Braak & Smeets, 1956).

The T. Tibbitts and T. Kozłowski (eds.) guidelines allow to: standardize methods of growing and analyzing plants in laboratory and greenhouse conditions; determine the optimal parameters of the environment for plant growth and development; conduct experiments on the influence of various factors (lighting, temperature, humidity, soil composition, etc.) on the physiological and morphological characteristics of plants; evaluate the effectiveness of fertilizers, growth regulators and other agrochemicals; develop recommendations for optimizing cultivation conditions to increase yield and quality (Tibbitts & Kozłowski, 1979).

Downs gives advice on flow and density in phytotrons (Downs, 1988). Other researchers pay attention to light (Biggs et al., 1971).

In Ukrainian and Soviet scientific literature, O. Sozinov's megaproject was seen as one of the key steps in the modernization of agricultural science in the USSR. The phytotron, created in the second half of the twentieth century, became the basis for the development of new crop varieties. Breeding technologies and methods were improved, which contributed to the efficiency of growing highly productive and resistant to unfavorable conditions varieties.

Sokolov notes that in the 70s of the last century, the world's largest phytotron was built, which made it possible to conduct research at a high scientific level regardless of the growing season (Sokolov, 2012). In addition, the author emphasizes that O. Sozinov's innovative research has always been characterized by the work of the Department of Genetic Basis of Breeding (Sokolov, 2012, p. 355).

Revealing the multifaceted figure of O. Sozinov, V. Vergunov notes "...the largest artificial climate station in the USSR, the phytotron, built during Sozinov's directorship, made it possible to significantly accelerate the breeding process." Thanks to the favorable conditions for scientific research and the talented leadership of O. Sozinov, young scientists were able to make world-class discoveries. A striking example of this is the achievement of his student, Corresponding Member of the National Academy of Sciences of Ukraine, State Prize winner O. Rybalka. He recalled that the results of his PhD thesis allowed them to be two years ahead of researchers from the University of Cambridge, having carried out the first mapping of the locus that encodes the biosynthesis of gluten proteins. Such breakthroughs seem almost unattainable in today's environment (Vergunov, 2018).

The scientific achievements of O. Sozinov (Sozinov, 1981b) became the basis for the development of modern breeding science in Ukraine, and also contributed to the integration of domestic research into the international scientific space.

The analysis of the literature shows that O. Sozinov's mega-project on the innovative transformation of the plant breeding system has made a significant contribution to the world and national agricultural science. The use of phytotrons has significantly accelerated the process of creating new varieties, increasing their resistance to adverse factors and, consequently, their yield.

The phytotron as a complex for artificially regulating plant growth conditions has opened up new opportunities for the development of the breeding process, increasing the efficiency of experiments, and creating new highly productive varieties. However, despite its significant contribution to the development of agricultural science, research into the history of this project remains undercovered.

The relevance of this topic is due to the need to rethink the scientific achievements of the past and their impact on modern agricultural technologies. The study of O. Sozinov's megaproject allows not only to assess the scientist's contribution to the development of breeding, but also to understand the prospects for the further use of phytotronic technologies in the world agricultural practice.

Methods and Materials.

The study is based on the principles of historicism and objectivity, which allowed us to reproduce with maximum accuracy the real historical picture of the implementation of O. Sozinov's project on the innovative transformation of the plant breeding system to increase productivity and yield. The use of the problem-chronological method allowed us to find out the reasons for the formation of established methods of conducting experimental work within this project, and the retrospective method allowed us to show the patterns of this process. The chronological method was used to achieve the appropriate sequence of presentation of the historical

information obtained, and the methods of logic, analysis and synthesis were used to draw the conclusions and provisions set forth in the article.

Results and Discussion.

In the second half of the twentieth century, the development of genetics in Ukraine took place in the context of the restoration of science after Stalin's repressions and the influence of official ideology.

In the 1950s and 1960s, the All-Union Breeding and Genetic Institute (ABGI) (now the Breeding and Genetic Institute – National Center for Seed and Variety Studies) was the center of the revival of genetics after the Lysenko period, and it became one of the key centers for the development of genetic research in the USSR. The Institute actively contributed to the restoration and development of modern genetic science, in particular, the study of molecular biology, plant and animal genetics, and crop breeding.

With the arrival of O. Sozinov, a new, dynamic stage in the life of the All-Ukrainian Scientific and Research Institute began. As a representative of the command-and-control system (in its best manifestation), he perfectly met its requirements. He was characterized by an authoritarian style of management, but at the same time demonstrated high efficiency, determination in decision-making and a desire for development. Under his leadership, favorable financial and organizational conditions were created for the work of employees (State Archives of Odesa Oblast. Fund P. 3139, Inventory 1, Case 44, Sheet 63), which contributed to the growth of the institution to a world-class level.

One of the key areas of his activity was to engage specialists in various fields – mathematicians, engineers, and representatives of related sciences – in cooperation. This contributed to the development of scientific areas that were important for the country's economy, led by him. In particular, a significant achievement was the creation of the phytotron, a unique agrobiological research complex that allowed monitoring of cultivated plants at all stages of their development, accumulating and processing huge amounts of information. This, in turn, brought agrobiological science to a qualitatively new level. It is thanks to the strategic vision and focused policy of O. Sozinov that the Institute received a new impetus for development, strengthening its position as one of the leading research centers.

After the period of dominance of the Lysenko theory, which denied the foundations of classical genetics, the Institute's scientists continued to develop new methods and approaches to the study of genetic processes. Scientists actively applied the achievements of world science, in particular, O. Sozinov, looking for new opportunities for the development of genetics and plant breeding, considered the phytotron as an innovative tool. It should be noted that a similar center had already been established in Germany using a phytotron, and its work was much more effective than the activities of the Department of Plant Production and Breeding of the GDR Academy of Agricultural Sciences (Dragavtsev, 2000).

After defending his PhD thesis, O. Sozinov worked under the supervision of Academician F. G. Kirichenko, learning the methods of barley breeding by

P. H. Garkavy and mastering the peculiarities of wheat breeding. He took an active part in the life of the institute's staff, holding the position of a collective boss, constantly spoke at postgraduate seminars and made numerous trips to rural regions. In 1961, at the suggestion of the director of the institute, O. Musiyko, he headed the grain quality laboratory. From the very first steps, he had to restore the operation of outdated equipment, organize its repairs, develop new methods and establish cooperation with breeders. The laboratory has become a recognized scientific and methodological center for grain quality in the former USSR. The laboratory's activities were not limited to preparing and holding union seminars and methodological meetings, but also included publishing methodological materials and organizing joint research with scientists from Moscow, Omsk, Kharkiv and other research centers (Vergunov et al., 2010, p. 24).

Between 1961 and 1971, when Oleksii Sozinov served as deputy director for scientific work at the All-Union Scientific Research Institute, he was able to implement large-scale changes aimed at overcoming the remnants of Lysenkoism in science. Thanks to his convictions and efforts, he was able to influence the director of the institute, O. S. Musiyko, and prove the importance of these changes for the further development of breeding science. In particular, the construction of a phytotron, which will allow controlling key environmental parameters such as temperature, humidity, lighting, and atmospheric composition. These conditions make it possible to accelerate plant growth, study their response to various factors, and conduct experiments to improve yields.

Construction of the phytotron began in 1967 and lasted ten years. However, the official opening of the facility was scheduled for the fall of 1978, due to the need to fully load all freezers with experimental material. This made it possible to ensure that the complex was ready for scientific research in optimal conditions (State Archives of Odesa Oblast. Fund R. 7881, Inventory 1, Case 152, Sheet 137–143).

Already on January 10, 1978, the Academic Council of the All-Ukrainian Scientific Institute, headed by O. O. Sozinov, approved a program of research on the phytotron (State Archives of Odesa Oblast. Fund P. 3139, Inventory 1, Case 68, Sheet 32). It is important to note that its development took into account international best practices in the field of phytotron research. In particular, the achievements of French scientists in the field of plant physiology, Australian scientists in the study of drought resistance, and Japanese scientists in plant reproduction were used (State Archives of Odesa Oblast. Fund R. 7881, Inventory 1, Case 152, Sheet 27).

This integrated approach has allowed us to create a scientifically based program aimed at improving plant breeding and genetics.

The complex consisted of three parts: a laboratory building, a technical block with greenhouses, and a block of climatic chambers. Built according to the original design, the complex was intended for genetic and breeding research in a wide range of temperatures and had 14 freezers (State Archives of Odesa Oblast. Fund R. 7881, Inventory 1, Case 152, Sheet 137–143).

The climatic chambers of the phytotron differed in their purpose, the range of adjustment of the main environmental parameters, and design features. Ten chambers with natural light were arranged in two tiers at different height levels. Each of the tiers

was a single building structure divided by glass partitions into five separate chambers, each with a floor area of 18 m².

The upper tier was equipped with double glazing, which allowed the temperature to be maintained between +15 and +35 °C. In the lower tier, where lower temperatures were required, triple glazing was used. The temperature regime here ranged from +5 to +25 °C. One of the chambers in the lower tier had the ability to create negative temperature values, which ensured that experiments could be conducted under artificial cooling conditions.

The stability of the microclimate in each chamber was maintained by autonomous air conditioners equipped with freon refrigeration units, which guaranteed precise temperature control in accordance with the research requirements.

In addition to the main climate chambers, the phytotron also had vegetation chambers and climate cabinets. They differed mainly in size, but had similar air conditioning systems that operated on a single-acting principle. The range of temperature control in these chambers was wider and ranged from +4 to +45 °C, which allowed for experiments in different climatic conditions (Sozinov, 1978b).

O. Sozinov realized that the introduction of the latest technologies in breeding should be accompanied by fundamentally new results that would be a breakthrough in the genetic field. To achieve this goal, it was necessary to conduct specialized scientific research, which was already being actively carried out and planned for the future. In particular, methods were developed to shorten the vernalization period of winter crops, and the optimal parameters of temperature, light exposure, and supply of plants with the necessary nutrients were determined.

Given the high cost of phytotron space, it was extremely important to plan experiments rationally and analyze the results in depth. For this purpose, it was necessary to apply mathematical methods of data processing. Quantitative characteristics of a number of key properties of genotypes have already been proposed, including competitiveness, environmental plasticity, response to improved growing conditions, etc. That is why, in addition to breeders, mathematicians were actively involved in the work in the phytotron (State Archives of Odesa Oblast. Fund R. 7881, Inventory 1, Case 152, Sheet 139), which made it possible to increase the efficiency of research.

One of the main tasks of the latest breeding technologies was to create varieties and hybrids characterized by comprehensive resistance to diseases and pests. Achieving success in this area largely depended on a detailed study of pathogens, determining their racial composition, and the effective selection and use of donors in the hybridization process. Other important factors were a deep understanding of the genetic mechanisms of field resistance of plants and providing an optimal background for the precise selection of genotypes that demonstrate high resistance to disease.

In the climatic chambers of the phytotron, scientists conducted in-depth research on cereal diseases, including brown leaf and stem rust, powdery mildew, smut, helminthosporiosis, viral infections, and other pathogens. Particular attention was paid to the study of pathogen genetics, their notypical composition, adaptation mechanisms, and the prediction of new races. At the same time, the resistance of different varieties

of wheat and barley to these diseases was studied, which is critical for maintaining grain yields and quality.

A separate area of research was devoted to studying the mechanisms of field resistance of grain crops to various pathogens and pests. In particular, attention was focused on the resistance of plants to rust fungi, powdery mildew, and viral infections, as well as their ability to resist cereal flies, aphids, moths, and other pests. O. Sozinov, together with other scientists, conducted a comprehensive identification of genes responsible for plant resistance, studied the conditions of their manifestation and the patterns of inheritance in the process of hybridization (Ursu, 2013).

This contributed to the development of new high-yielding varieties with a broad genetic basis and comprehensive immunity to biotypic variability of pathogens.

In addition, a thorough phytopathological assessment of wheat and barley breeding material was carried out in the climatic chambers of the phytotron. The tests included analysis of resistance to yellow rust, viral diseases and damage caused by pests. The use of the phytotron significantly accelerated the breeding process, as it allowed for several generations of full-grown plants within a year, which made it possible to perform complex crosses for resistance breeding more efficiently. This has led to the accelerated development of new varieties that can adapt to changing growing conditions and the impact of pathogens.

In the second half of the twentieth century, breeding research aimed at improving the immunity of crops focused on creating new donors with comprehensive resistance to adverse conditions and high economic value. It was especially important to develop winter wheat and barley varieties that would combine resistance to rust, powdery mildew, and low temperatures. However, such genotypes were extremely rare in the wild, which complicated the breeding process.

The use of climatic and freezing chambers greatly expanded the capabilities of breeders, allowing them to select the most promising samples in a targeted manner. These technologies provided for a comprehensive study of breeding material that was grown in a phytotron and simultaneously tested in several ecologically different regions. Field experiments, even with the use of artificially created climatic conditions, remained a key stage of research, as they provided the most reliable assessment of genotype behavior in the real environment.

At the same time, the use of the phytotron significantly increased the efficiency of breeding. It complemented field research by providing a comprehensive assessment of the adaptive potential of plants and allowing unsuitable genotypes to be rejected before they were tested in the field. This approach helped to accelerate the process of creating promising varieties with high resistance to biotic and abiotic stress factors.

O. Sozinov proposed a system of symbols for allelic blocks and a methodology for recording genetic varietal prolamine formulas. The scientist's research has confirmed that certain allelic blocks not only determine the technological properties of grain, but also have a connection with frost resistance, disease resistance, and other agronomically important traits. Since the electrophoretic analysis of prolamines is independent of growing conditions, the identification of varietal formulas can be performed on grain grown under controlled conditions (phytotron, greenhouses). One

or even half a grain is sufficient for the analysis, making this method extremely efficient and affordable. At the same time, new genetically determined differences between genotypes were identified, including their specific responses to different parts of the solar spectrum. This opened up new perspectives in the study of photosensitivity mechanisms and their impact on plant growth, development, and productivity, which is of great importance for crop breeding and adaptation to climate change.

Since the opening of the phytotron, most of the scientific research in Odesa region has been conducted on its basis. Thanks to the introduction of modern technologies, plant breeders have expanded the range of research methods, actively using cultures of plant cells, tissues and embryos. Particular attention was paid to the cultivation of embryos, which opened up new opportunities for obtaining distant hybrids and creating haploid genotypes (State Archives of Odesa Oblast. Fund R. 7881, Inventory 1, Case 152, Sheet 141), which, in turn, became a key tool in solving the problem of homozygosity of breeding material and the identification of promising homozygous amphiploids that are highly valuable for breeding and further improvement of crops.

The second half of the twentieth century saw a real revolution in the biological sciences, particularly in the field of genetics, driven by the development of transformation and transgenesis technologies, the process of transferring genetic information at the DNA level. Although at that time there was not yet sufficiently convincing evidence of the possibility of successful transgenesis in higher plants, this research was actively developing. This was due to the assumption that genetic engineering methods could have a significant impact on breeding, opening up new perspectives in creating plants with valuable economic traits.

A prominent Ukrainian scientist, O. Sozinov, was one of the leading proponents of this area of research. He believed that progress in molecular biology would facilitate the rapid detection and identification of valuable genes, which, in turn, would be of great importance for practical breeding. The scientist emphasized the importance of studying the mechanisms of gene interaction in the genetic system of organisms, especially under conditions of controlled cultivation (State Archives of Odesa Oblast. Fund P. 3139, Inventory 1, Case 68, Sheet 30–34). He saw in these studies not only fundamental value, but also direct applied value for improving breeding methods.

O. Sozinov identified two key areas of such research. The first one concerns the study of genetic interactions within pairs of alleles, taking into account their pleiotropic effect. In particular, it is about establishing the patterns of so-called “floating dominance” and identifying factors that affect the degree of dominance of traits in hybrid plants depending on growing conditions. This made it possible to predict when full dominance, intermediate dominance, variability, or overdominance would occur. The second direction is aimed at studying inter-allelic interactions in polygenic systems that determine quantitative traits. Particular attention was paid to the effects of additive, dominant, and epistatic gene effects, with additive action playing a key role. It largely determines the level of the coefficient of inheritance of traits and affects the efficiency of the breeding process (Sozinov, 1978b, p. 111). Thus, the development of genetic engineering and in-depth study of the mechanisms of genetic interactions have opened

up new opportunities for improving cultivated plants, which has become the basis of modern approaches in breeding and agricultural biotechnology.

An important stage in the institution's activities under O. Sozinov's leadership was overcoming the isolation from world science, which had long hindered its development, contributing to provincialism and technological lag. Realizing the need to integrate into the international scientific space, O. Sozinov made significant efforts to establish cooperation with the world's leading scientific centers. However, the first steps in this direction were made in 1966–1970, when the party bureau decided to approve the characteristics for foreign business trips of researchers (State Archives of Odesa Oblast. Fund R. 7881, Inventory 1, Case 294, Sheet 35). This became the starting point for active international knowledge exchange, which allowed researchers to establish contacts with leading foreign institutions, adopt best practices, and introduce modern methods into domestic breeding. Subsequently, the Institute expanded the scope of cooperation by concluding agreements with scientific institutions in Europe and America (State Archives of Odesa Oblast. Fund P. 3139, Inventory 1, Case 59, Sheet 28), organizing joint research, international conferences and internships. This contributed to the introduction of innovative technologies in the breeding process, raising the level of domestic agricultural science and strengthening the Institute's position in the global scientific arena. It is worth noting that, according to the decision of the 25th session of the Council for Mutual Economic Assistance (CMEA), the All-Ukrainian Agricultural Institute under the leadership of O. O. Sozinov was transformed into a focal point for the development of theoretical principles of breeding and seed production, as well as the creation of high-yielding varieties and hybrids of crops for CMEA member countries.

Odesa received hundreds of samples of wheat, barley, and other crops from all CMEA member countries, which facilitated active international exchange of genetic material. In one of the world's largest phytotrons, these samples were sown in a quarantine nursery, where they underwent careful adaptation and evaluation. Later, the best of them were used to create new varieties and hybrids that met the agroclimatic conditions of both Ukraine and other CMEA member states (Lyfenko, 2012). The Institute's activities were of strategic importance for the development of agriculture, as it provided countries with highly productive seed material, which helped to increase yields and food security in the region.

The history of the successes of the phytotron and the All-Union State Institute of Agriculture, recognized at the level of the USSR, can be documented in the events that took place from the beginning of Sozinov's project to the last year of the scientist's stay in Odesa. In particular, on August 21, 1978, at the XIV International Genetic Congress held in Moscow, the effectiveness of the phytotron at the All-Union State Institute of Genetics was highly appreciated. The participants of the event noted the significant contribution of the institution to the development of genetic research, emphasizing the role of the phytotron in conducting experiments on plant breeding and improvement (Sozinov, 1978a).

On December 6–7, 1978, at the session of the General Meeting of the USSR Academy of Sciences, O. Sozinov presented the results of research that confirmed the

effectiveness of using the phytotron in studying the genetic characteristics of plants. The contribution of the All-Union Agricultural Institute specialists to the improvement of breeding methods based on the use of phytotronic technologies was particularly noted, which opened up new prospects for genetic research and increased crop yields (Sozinov, 1979a; 1979b).

In 1980, the city of Hamburg hosted a scientific forum on security and cooperation in Europe. The event brought together leading specialists, scientists and experts from different countries to discuss topical issues of science and technology development. One of the highlights of the forum was a presentation by O. Sozinov, who highlighted the achievements in the field of scientific research using phytotron, focusing on the prospects of using this technology to improve the efficiency of agricultural production and study physiological processes in plants under controlled conditions. The participants of the event highly appreciated the contribution of the phytotron, which operated at the All-Ukrainian Agricultural Institute, noting its significant role in the development of agricultural science. They emphasized the importance of further research in this area and international cooperation to improve plant cultivation methods and ensure food security (Sozinov, 1981a).

In 1978, the Academic Council of the Institute nominated O. Sozinov for full membership in VASKhNIL. The Institute's submission stated: "O. O. Sozinov is widely known for his contribution to the development of the genetics of the protein complex of cereals. Since 1958, he has been working extensively on improving grain quality. Since 1971, he has been the director of the All-Union Breeding and Genetic Institute. In recent years, he has developed more than 30 new varieties, which are grown on an area of more than 10 million hectares, with a net profit of 588 million rubles." To this figure was added another one - "...due to the introduction of Sozynov's varieties into production, the country additionally received 7201.1 thousand tons of grain (State Archives of Odesa Oblast. Fund P. 7881, Inventory 1, Case 152, Sheet 62–64).

In his early fifties, O. O. Sozinov became well known in Ukraine and abroad as an outstanding geneticist and science organizer. He was elected an academician of the Academy of Sciences of the Ukrainian SSR in the specialty of genetics and was awarded the highest state honors: the Order of Lenin (1973), the Order of the October Revolution (1977), and the Red Banner of Labor (1971).

At a meeting of the Institute's Academic Council on October 20, 1978, Director O. O. Sozinov announced that he had been appointed Vice President of the All-Union Academy of Agricultural Sciences and would simultaneously head the Laboratory of Biochemical Genetics of the Institute of General Genetics at the main academy of the country, the USSR Academy of Sciences (State Archives of Odesa Oblast. Fund P. 7881, Inventory 1, Case 152, Sheet 62).

Conclusions.

In the second half of the twentieth century, Ukrainian plant breeding science made a significant step forward through the introduction of the latest technologies and innovative approaches. Academician O. Sozinov played an important role in this

process, not only by creating a powerful research center, but also by initiating the use of technologies unique for his time, in particular the phytotron. This made it possible to significantly speed up the breeding process, improve control over plant cultivation, and expand the possibilities of research in genetics and breeding.

The phytotron has become a revolutionary platform for testing and developing new crop varieties, which has significantly reduced the time required for breeding experiments. The use of a controlled environment has allowed scientists to explore the impact of climatic factors on plant development in greater depth, ensuring better adaptation to different environmental conditions. In particular, this contributed to the development of high-yielding varieties of wheat, corn, soybeans and vegetables, which became the basis for the further development of Ukraine's agricultural sector.

Despite its successes, the implementation of O. Sozinov's mega-project faced serious difficulties. The financial crisis that followed the collapse of the USSR led to the decline of research infrastructure, including the phytotron. The functioning of such a high-tech facility became impossible due to the lack of adequate funding and support from the state. This led to the loss of a unique tool that could have served as a basis for the development of modern genomics and biotechnology.

However, even in such circumstances, the scientific heritage of Academician Sozinov has not lost its relevance. His ideas and approaches to breeding research remain the basis for further developments in the field of agricultural science. The Phytotron demonstrated the prospects of creating controlled conditions for breeding, which in the XXI century has been continued in modern biotechnology laboratories and research in the field of genetic engineering.

Thus, O. Sozinov's megaproject not only made a significant contribution to the development of plant breeding in the second half of the twentieth century, but also left a significant scientific heritage that still influences the development of agricultural science and biotechnology in Ukraine and the world. And the development of breeding technologies based on the use of phytotrons was an important step in improving the efficiency of agricultural science in the second half of the twentieth century.

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Conflicts of Interest.

The author declare no conflict of interest.

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Мегапроект з інноваційної трансформації системи селекції рослин для підвищення продуктивності та врожайності (друга половина ХХ століття)

Анотація. Метою статті є реконструкція подій та аналіз наукової діяльності вченого-генетика Олексія Олексійовича Созінова (1930–2018), спрямованої на розвиток сільськогосподарської науки в Україні. Особливу увагу приділено створенню та розвитку фітотрону у Всесоюзному селекційно-генетичному інституті (нині – Селекційно-генетичний інститут – Національний центр насіннізнавства та сортовивчення) у другій половині ХХ ст. Досліджено ініційовану О. Созіновим інноваційну трансформацію системи селекції рослин, спрямовану на підвищення продуктивності та врожайності сільськогосподарських культур. Використання методів мікроісторії та порівняльно-історичного аналізу дозволило глибше розкрити науковий внесок ученого та його вплив на розвиток селекційної науки і технологій. На основі опрацювання архівних матеріалів уперше введено в науковий обіг комплекс джерел, що дозволяють переосмислити значення розробок О. Созінова та його колег у створенні й функціонуванні фітотрону. Аналіз документальних матеріалів Державного архіву Одеської області та інших джерел дав змогу розширити уявлення про застосування фітотронних технологій у селекційній діяльності та їхній вплив на аграрну науку й підвищення врожайності сільськогосподарських культур. Окреслено внесок О. Созінова у розвиток наукових досліджень у галузі селекції та генетики, зокрема впровадження передових експериментальних методів і використання фітотрону для досліджень зернових культур. Доведено, що багаторічний досвід ученого у сфері селекції та генетики рослин став основою для формування довгострокових наукових напрямів у цій галузі. Запроваджені ним експериментальні підходи сприяли інноваційній трансформації системи селекції, що забезпечило суттєве підвищення продуктивності та врожайності сільськогосподарських культур. Зроблено висновок, що наукові здобутки О. Созінова не лише заклали фундамент для подальших досліджень, а й визначили перспективи розвитку галузі на десятиліття вперед. Використання фітотрону значно розширило можливості дослідження впливу різних факторів на ріст і розвиток рослин, що, своєю чергою, сприяло створенню нових високопродуктивних сортів.

Ключові слова: Олексій Созінов; селекція рослин; фітотрон; генетика; аграрна наука; інноваційна трансформація

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