DOI https://doi.org/10.36059/978-966-397-100-1/87-105

PECULIARITIES OF SCIENTIFIC SCHOOLS' ACTIVITY DIRECTIONS TO IMPROVE AGROECOSYSTEMS IN FOREST-STEPPE OF UKRAINE (SECOND HALF OF THE XIXth – BEGINNING OF THE XXIst CENTURIES)

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INTRODUCTION

At the beginning of the XXIst century, the development of agricultural sector of Ukraine was ensured by the introduction of effective agroecosystems based on the use of scientifically grounded structure of the cultivated areas and specialized crop rotations with efficient alternation of different biological crop groups, rational fertilization and cultivation systems application, as well as environmentally safe measures[1]. Their introduction solved important practical tasks in two directions: soil fertility reproduction and natural environment preservation, as well as providing high-quality food for the population of Ukraine[2].

Improvement of agroecosystems in different soil climatic conditions of Ukraine was based on the accumulation and synthesis of scientific knowledge provided by favorable conditions for scholars' scientific creativity capable of expanding effective search activity[3]. It became important to find out the preconditions for creation, regularities and activity specifics of the scientific teams of researchers, for systematizing their scientific developments to improve agroecosystems for different soil and climatic conditions of Ukraine[4]. The scientific school was regarded as an informal creative community of different generations of highly qualified scholars led by a scientific leader within a certain research direction[5]. They

[1] Бойко П. І., Блащук М. І., Демиденко О. В. Сівозміни та родючість чорнозему Лівобережного Лісостепу : монографія. Сміла, 2019. 450 с.

[2] Бойко П. І. Біологічна та екологічна роль сівозмін у землеробстві. Київ: Знання, 1990. 48 с.

[3] Коваленко Н. П. Становлення та розвиток науково-організаційних основ застосування вітчизняних сівозмін у системах землеробства (друга половина XIX – початок XXI ст.) : монографія. Київ: ТОВ «Нілан-ЛТД», 2014. 490 с.

[4] Юркевич Є. О., Коваленко Н. П., Бакума А. В. Агробіологічні основи сівозмін Степу України: монографія. Одеса: Одеське видавництво «ВМВ», 2011. 240 с.

[5] Онопрієнко В. І., Ткаченко В. М. Історія української науки. Київ, 2010. 652 с.

were united by common approaches to problems solving, work style and thinking, the originality of ideas and methods of implementing scientific programs. They have obtained important results; have authority and public recognition in certain fields[6].

The integrity of the scientific school was ensured by the organic integration of individual scientists' and generations' scientific research, united by the general program and style of research work. Structuring and hierarchy, which was conditioned by the subordination and features of the internal structure of the scientific school formed under the leadership of a scientist-leader. Multifunctionality, which consisted in the implementation of educational, informative, research, social and cultural, and other functions. Mandatory criteria of the scientific school was the ability to independently maintain or improve the level of their organization when changing the internal or external conditions of existence, to function to increase the stability, integrity. Purposefulness, provided by the activity subordination to clearly defined research program, the continuous development of certain scientific directions by several generations of scientists[7]. Effectiveness was significant, which was determined by the level of scientific production received; the ability to popularize the scientific school scholars' achievements: publications, seminars, conferences, etc.

The preconditions for the scientific schools formation to improve agroecosystems were the theoretical knowledge accumulation and organizing, the availability of a full research program for the future, which was possible only with the organization of sectoral institutions network. The main centers of their creation were the departments of higher educational institutions and laboratories of research institutes, which played the role of the leading units of fundamental and applied branch knowledge accumulation, multiplication and spreading. In the second half of the XIXth and early XXth centuries, a great number of branch scientific schools were established, analyzing the activity directions for agroecosystems improvement in different soil and climatic conditions of the Forest-Steppe region of Ukraine provided the use of the most significant achievements of the past for long-term development of agrarian science and practice based on regional peculiarities.

[6] Микулинский С. Р., Ярошевский М. Г. Школы в науке. Москва: Наука, 1977. 523 с.

[7] Храмов Ю. А. История формирования и развития физических школ на Украине. Киев: Феникс, 1991. 216 с.

1. Contribution of Scientific Schools Researchers for Agroecosystems of Grain Direction Development

A well-known scientific school for agroecosystems of grain direction development in the Right-Bank Forest-Steppe of Ukraine was founded in 1868 in the Uman Agricultural and Horticulture College (now Uman National Horticulture University). Even at the beginning of its foundation by Professor A. S. Husakivskii, efficient technologies of crops growing in crop rotations of the Right-Bank Forest-Steppe of Ukraine were developed[8]. In 1912 theoretical and methodological aspects of efficient crop growing technologies in crop rotations were developed by Professor M. K. Vasiliev, who published a textbook «Private agriculture or field and meadow crops doctrine», which for a long time was a major for agricultural educational institutions.

Professor S. S. Rubin was the follower of this scientific school and he identified the best grain crops precursors, timely periods of soil cultivation and fertilizers application in crop rotations in the conditions of the Right-Bank Forest-Steppe of Ukraine. His students Professors V. P. Hordienko, V. O. Yeshchenko substantiated theoretical and methodological bases for the application of surface soil cultivation under grain crops[9]. In the second half of the XXth century, the scientific school received recognition through the development and implementation of: effective grain crop rotation by P. M. Fedchenko; covering crops for long-term bean grasses in forage crop rotations by H. D. Derkach, O. I. Zinchenko; multifaceted crop rotation with different steam types and a wide range of winter wheat precursors by A. F. Dichtiar, S. S. Rubin. Scientists have identified effective directions for agroecosystems development: I. M. Karasiuk – fertilizer systems in grain crop rotations; O. I. O'lkhovska – precursors in field crop rotations; O. M. Lipinskii – farmland crop rotations with different saturation of intermediate crops by; V. S. Pidvysotskii – precursors in seed crop rotations[10].

Researches of the scientific school paid much attention to the establishment of theoretical and methodological foundations for the optimization of agroecosystems: perennial grasses – annual grasses

[8] Коваленко Н. П. Становлення та розвиток науково-організаційних основ застосування вітчизняних сівозмін у системах землеробства (друга половина XIX – початок XXI ст.) : монографія. Київ: ТОВ «Нілан-ЛТД», 2014. 490 с.

[9] Карасюк І. М., Замаховська М. Ю. Уманська сільськогосподарська академія (1884–1999). Київ: Сільгоспосвіта, 1999. 47 с.

[10] Бойко П., Данилевский А. Координационное совещание. *Земледелие.* 1973. № 10. С. 79.

rotation by O. P. Danylevskyi, S. S. Rubin; effective precursors for strong varieties of winter wheat with fertilization by O. B. Karnaukh, Yu. F. Tereshchenko; agroecological assessment of crop rotation by V. O. Yeshchenko, V. P. Oprysko; specialized crop rotations with grain crops and sugar beet growing by V. P. Hordienko[11]. At the beginning of the XXIst century, the nearest hear of S. S. Rubin's scientific traditions Professor V. O. Yeshchenko for the first time comprehensively described the effective field crop rotations of various economic directions in agroeconomic terms. His students made a significant contribution to the development of effective agroecosystems: V. P. Opryshko has developed crop rotations with optimum saturation of grain crops; S. P. Koval', A. V. Novak have worked out a wide range of effective precursors for oilseeds and rapeseed; M. V. Kaliievskii has determined the rational basic tillage of soil under oilseed flax; S. V. Usik has scientifically grounded crops alternation in crop rotations with short-term rotation.

Scientists have published more than 100 scientific works. The most important are the following: S. S. Rubin's monographs «Crop Rotation» (1962) and «So that the soil was fertile» (1969); V. O. Yeshchenko's, P. H. Kopytko's, V. P. Opryshko's monograph «Crop Rotation of the Forest-Steppe Zone» (2007). Of great importance were textbooks and tutorials: «General Agriculture» (1964), «Agriculture» (1980) by S. S. Rubin; «General Agriculture» (2004) V. O. Yeshchenko; «Crop rotations in agriculture of Ukraine» (2008) by I. D. Primak, V. O. Yeshchenko, Yu. P. Man'ko and numerous methodological guidelines for the practical implementation of crop rotation of various types[12]. Over 80 Candidates and Doctors of Sciences have been trained by the scientific school. At the beginning of the XXIst century, researches of the scientific school continued their activity, solving the following tasks: agroecological substantiation of short-term crop rotations with high grain crops saturation; development of minimization of the basic soil cultivation under grains and row crops; agroecological substantiation of weed control measures in crop rotations of the Right- Bank Forest-Steppe of Ukraine.

[11] Коваленко Н. П. Становлення та розвиток науково-організаційних основ застосування вітчизняних сівозмін у системах землеробства (друга половина XIX – початок XXI ст.) : монографія. Київ: ТОВ «Нілан-ЛТД», 2014. 490 с.

[12] Коваленко Н. П. Становлення та розвиток науково-організаційних основ застосування вітчизняних сівозмін у системах землеробства (друга половина XIX – початок XXI ст.) : монографія. Київ: ТОВ «Нілан-ЛТД», 2014. 490 с.

Scientific school for the development of grains agroecosystems in the Forest-Steppe of Ukraine deserves attention. It is well-known in Ukraine and abroad. It was founded in the Central Agrochemical Laboratory (now NSC «Institute of Agriculture of NAAS») in 1898. From the beginning of its creation under the guidance of Academician O. I. Dushechkin systematic studies on the effective introduction of mineral fertilizers have been initiated, namely: superphosphate, nitrate, tomaschek; chemical reclamation: liming of acid and gypsum of salt-soaked soils; effective saturation of crop rotation with grain crops[13]. At the beginning of the XXth century, the extension of systematic research to improve lime and other agrochemical measures application in crop rotation of the Forest-Steppe of Ukraine was continued by the closest O. I. Dushechkin's student, Candidate of Sciences F. A. Popov. He has published more than 110 scientific works. His monograph «On insolvency of grasslands in the scientific foundations of agriculture system» (1961) is the most significant. Professor O. M. Nadezhdin has developed effective grain crop rotation; candidate of science I. L. Kolosha has substantiated effective fertilizer systems; H. H. Makhov has introduced soil protective crop rotation for erosional hazardous soils.

In the second half of the XXth century, the scientific school received recognition due to the Candidate of Sciences V. O. Pastushenko's new approaches definition to the theoretical and methodological foundations of crop rotation of various types, saturated 40–100% by grain crops, 10–40% by industrial crops, 10–60% by forage and intermediate crops for various specialization of agricultural production[14]. Researches of the scientific school P. I. Boiko, I. H. Zakharchenko, V. V. Kul'bida, H. K. Medvid', I. H. Predko firstly established scientific and methodological principles of agricultural crops placement in grain and row crop rotations for farms of the Northwest Forest-Steppe of Ukraine. The phenomenon of incompatibility of crops, allelopathic soil fatigue and other biological factors that inhibited the growth of crop rotation productivity. Theoretical, methodological and practical bases of anti-erosion measures, which included the anti-erosion organization of the

[13] Довідка про науково-дослідні установи сільського господарства Української РСР за 1953 р. *Центральний державний архів вищих органів влади та управління України.* Ф. Р-27. Оп. 18. Спр. 7874. Арк. 1–44.

[14] Бойко П. І., Блащук М. І., Демиденко О. В. Сівозміни та родючість чорнозему Лівобережного Лісостепу : монографія. Сміла, 2019. 450 с.

territory and the introduction of soil protection crop rotation[15]. Scientists have developed effective soil tillage systems, fertilizers, crop rotation under irrigation conditions, rational irrigation regimes of agricultural crops in different soil-climatic conditions. Measures to combat soil salinization and swamping; improving the quality of agricultural products, depending on the crops composition and alternation. Creation and preservation of multi-year hay-grazing and pasture lands of high productivity by introducing meadow crop rotation with different saturation of row crops in the Forest-Steppe of Ukraine.

At the beginning of the 1990s the researches of the scientific school for the first time in Ukraine introduced systematic research of the nitrogen cycle in the system «soil – fertilizer – plant – water – atmosphere» using a stable nitrogen isotope, parameters of symbiotic and non-symbiotic nitrogen fixation in field conditions. Under the guidance of V. O. Pastushenko more than 170 scientific works have been published, namely: the monographs: «Crop rotations in collective farms of Ukraine» (1959), «Soil erosion and measures to overcome it» (1961), «Crop rotations in Ukraine» (1966, 1972), «Intensive crop rotations of the Forest-Steppe and Polissya» (1975). His students have greatly expanded theoretical and methodological work on the improvement of grain agroecosystems in different soil-climatic conditions of Ukraine. One of the areas that has received extensive development in agriculture, was formed by the Candidate of Science I. H. Zakharchenko, who for the first time in Ukraine on a large scale has established a balance of nutrients in intensive grain crop rotations. Mentioned scientific direction has been expanded by the Candidate of Science of H. K. Medvid', who for the first time has developed the theoretical and methodological foundations of quantitative and qualitative estimation of profitable and expense balances of nitrogen in grain crop rotation[16]. The second direction, which received wide development in agriculture, was formed by Doctor of Sciences V. V. Kul'bida, who for the first time has established theoretical and methodological bases for the intensification and biologization of grain crop rotations by increasing the role of post-harvesting and post-mowing crops. This scientific direction has been enlarged by the Candidate of Sciences

[15] Науковий звіт Українського науково-дослідного інституту землеробства за 1965 р. *Центральний державний архів вищих органів влади та управління України.* Ф. Р-27. Оп. 21. Спр. 34. Арк. 1–274.

[16] Коваленко Н. П. Становлення та розвиток науково-організаційних основ застосування вітчизняних сівозмін у системах землеробства (друга половина XIX – початок XXI ст.) : монографія. Київ: ТОВ «Нілан-ЛТД», 2014. 490 с.

I. H. Predko, who for the first time has identified the scientific and practical bases of intensive grain-row crop rotations for the Forest-Steppe of Ukraine.

The research on the improvement of the theoretical and methodological foundations for corn and other crops growing in the intensive specialized crop rotations of the Forest-Steppe of Ukraine was continued by the nearest student of V. O. Pastushhenko. Professor P. I. Boiko, who has headed the scientific school since 1992 carried out a comprehensive agrotechnical evaluation of corn precursors in accordance with the effect of factors of agriculture intensification[17]. The ecological factors of soil fatigue have been established under the influence of corn and other crops, namely: the formation of negative allelopathic soil effects and the toxicity of plants roots in their constant growth.

At the beginning of the XXIst century, under Professor P. I. Boiko's guide researchers of the scientific school O. O. Artiushenko, V. O. Borodan', N. P. Kovalenko, V. V. Kul'bida both have developed theoretical and methodological bases and ecologically safe technologies of soil fertility reproduction and this process control system by means of rational land use and created the models of soil protection systems of agriculture using highly effective fertilizers and chemical melioration in the conditions of Forest-Steppe of Ukraine[18]. Biological and agroecological principles of organization of zonal agroecosystems, scientific and practical bases of long-term crop rotation for large farmlands of different specializations and highly specialized short-term crop rotation for farms have been established. They have determined the effectiveness of alternative agriculture with the maximum use of biological means of intensification, agricultural systems for soil protection from erosion in the Forest-Steppe of Ukraine[19].

Professor P. I. Boiko for the first time has initiated comprehensive fundamental research on determining the influence of biological factors on soil fertility on crop rotation productivity, fertility and phytosanitary state of soil in order to overcome the negative effects soil fatigue. His student – the Director of the SEC «Institute of Agriculture of the NAAS», Academician V. F Kaminski has firstly substantiated the

[17] Бойко П. І., Блащук М. І., Демиденко О. В. Сівозміни та родючість чорнозему Лівобережного Лісостепу : монографія. Сміла, 2019. 450 с.

[18] Звіт про науково-дослідну роботу Українського науково-дослідного інституту землеробства за 1986–1990 рр. *Науковий архів ННЦ «Інститут землеробства НААН».* Оп. 2. Спр. 839. Арк. 1–501.

[19] Звіт про науково-дослідну роботу Інституту землеробства УААН за 2001–2005 рр. *Науковий архів ННЦ «Інститут землеробства НААН»*. Оп. 2. Спр. 938. Арк. 1–364.

agrobiological bases of intensification of leguminous crop growing in crop rotations in the Forest-Steppe of Ukraine; has published more than 130 scientific works, and obtained 2 patents for his inventions. Professor P. I. Boiko's students have made a significant contribution to the elaboration of theoretical and methodological foundations of efficient agricultural crops alternation in grain – row rotations in the Forest-Steppe of Ukraine: M. M. Nazarenko – corn for grain; K. M. Vishniakova – corn for grain and silage; Yu. I. Sologub – sugar beets; O. V. Yegorov – potatoes; O. Ye. Koretski, M. H. Furmanets' – winter wheat; L. S. Kvasnits'ka – grain crops[20]. Professor P. I. Boiko has published more than 280 scientific works, including the monographs «Corn in intensive crop rotation» (1990), «Crop rotation and fertility of black soil of the Left-Bank Forest-Steppe of Ukraine» (2019); textbook «Ecological problems of agriculture» (2010). Numerous scientific and methodological publications are of a great importance, including the scientific work «Prediction humus level of black soils of Forest-Steppe of Ukraine depending on the application of crop rotation, fertilization and tillage» (2019) in publication «International Journal of Ecosystems and Ecology Science», which is included in the Web of Science international science and technology base.

At the beginning of the XXIst century, the scientists solved the following tasks: scientific substantiation of theoretical and methodological foundations and practical implementation of crop rotation on the basis of soil fertility control, quantity and quality of harvest, economic and energy evaluation of mentioned measures. Improvement of agroecosystems with optimal placement of crops adapted to the soil-climatic conditions and specialization of farms. Development and implementation of grain crop rotation with different rotation for farms of wide specialization by means of cultural agroecosystems models creation, taking into account elements of organic farming[21]. Over 100 Candidates and Doctors of Science have been trained by the science school.

[20] Бойко П. І., Блащук М. І., Демиденко О. В. Сівозміни та родючість чорнозему Лівобережного Лісостепу : монографія. Сміла, 2019. 450 с.

[21] Коваленко Н. П. Становлення та розвиток науково-організаційних основ застосування вітчизняних сівозмін у системах землеробства (друга половина XIX – початок XXI ст.) : монографія. Київ: ТОВ «Нілан-ЛТД», 2014. 490 с.

2. Achievements of Scientific Schools for Grain-Row Agroecosystems Improvement

A well-known scientific school in Ukraine and outside the country for the development of grain-row agroecosystems in Forest-Steppe of Ukraine was founded in 1898 in the agricultural department of the Kyiv Polytechnic Institute (now the National University of Life and Environmental Sciences of Ukraine). Since its foundation Professor M. P. Chyrvinskii has established and Professor P. P. Sliozkin has developed the application of effective technologies for winter wheat and sugar beet growing in crop rotations with rational fertilizer systems use. Professor O. V. Klucharov has determined the efficiency of complex combination of soil cultivation and fertilization in grain – beet crop rotations application in the Forest-Steppe of Ukraine[22].

Professor V. V. Kolkunov has made a great contribution to the development of the theoretical basis for effective grain crops and sugar beet growing in crop rotations in the conditions of insufficient moisture of the Forest-Steppe of Ukraine. Professor A. H. Michalowskii has firstly determined frost resistance of winter crops in crop rotations and developed their effective alternation with sugar beet. Professor A. H. Ternichenko has established effective winter rye growing in crop rotations and its best precursors. Professors O. Yu. Barabash, Eu. P. Votchal, I. M. Hudkov, H. I. Demydas' have carried out priority research on the determination of effective crop rotation with different saturations of cereals, row and forage crops. In the second half of the XXth century, the scientific school received recognition for Professor's A. H. Michalowskii and his students' effective agricultural practices development and implementation for the rational use of field land according to the intensive farming system in the Forest-Steppe of Ukraine[23]. The nearest followers of A. H. Michalowskii's scientific traditions – Professors V. P. Hudz', V. M. Caliberda, E. F. Manoilenko have developed theoretical and methodological foundation for the introduction of mixed, post-harvesting and post-mowing crops in grain – row crop rotation and their rational fertilization.

[22] Діденко В. В. Нарис історії Національного аграрного університету (до 100-річчя заснування). Київ: Аграрна наука, 1998. 175 с.

[23] Науковий звіт про виконання тематичного плану науково-дослідних робіт агрономічного факультету УСГА за 1962 р. *Центральний державний архів вищих органів влади та управління України.* Ф. Р-27. Оп. 20. Спр. 184. Арк. 1–320.

Effective growing of high-yielding row crops in combination with winter wheat in grain – row crop rotations and the best precursors' determination for winter grain crops were worked out by Professor V. M. Caliberda[24]. He has determined the productivity of crop rotation sections, depending on the saturation of grains, sugar beet, post-harvesting and post-mowing crops; has established the most high-yielding crop rotation sections with fallow, occupied by fodder lupine and peas. He has also recommended the placement of winter grain crops after occupied fallows and green manure crops for the rational use of peat soils of dried bogs in the Forest-Steppe of Ukraine[25].

The theoretical and methodological aspects of developing an effective fertilizer system in crop rotations have been developed by Academician P. A. Vlasiuk. He has determined the effectiveness of dunging and mineral fertilizers combination in sowing and basic fertilization[26]. Professor M. H. Horodnii has found effective use of organic and mineral fertilizers in specialized hemp crop rotations. Professor M. M. Horodnii has identified the effective fertilizer system with elements of biologization in different crop rotations. Professor M. K. Shikula has developed the basic model and implemented the soil protection system of agriculture with contour-melioration land management, has implemented the soil protection crop rotations to protect soil from erosion. Academician O. Yu. Barabash has established the effective alternation of vegetable crops in specialized crop rotations for different soil-climatic conditions of the Forest-Steppe of Ukraine[27].

At the beginning of the XXIst century, priority research on the development of theoretical and methodological foundations of the protection measures integrated system for grain crops and sugar beet from weeds have been carried out by Professors I. V. Veselovskii, V. P. Hudz[28]. Researchers of the scientific school have determined the effectiveness of

[24] Довідка від 30 грудня 1964 р. в ЦК КПУ про заходи з підвищення культури землеробства. *Державний архів м. Київ.* Ф. Р-1331. Оп. 3. Спр. 4515. Арк. 1–24.

[25] План і звіт про науково-дослідну роботу кафедри загального землеробства УСГА за 1970 р. *Державний архів м. Київ.* Ф. Р-1331. Оп. 11. Спр. 161. Арк. 1–169.

[26] Науковий звіт факультету ґрунтознавства і агрохімії УСГА за 1962 р. *Центральний державний архів вищих органів влади та управління України.* Ф. Р-27. Оп. 20. Спр. 191. Арк. 1–309.

[27] Діденко В. В. Нарис історії Національного аграрного університету (до 100-річчя заснування). Київ: Аграрна наука, 1998. 175 с.

[28] Коваленко Н. П. Становлення та розвиток науково-організаційних основ застосування вітчизняних сівозмін у системах землеробства (друга половина XIX – початок XXI ст.) : монографія. Київ: ТОВ «Нілан-ЛТД», 2014. 490 с.

growing corn and fodder beans on silage in row crop rotations, forage lupine – in field crop rotations; effective methods of soil cultivation have been established in combination with fertilizers in multiple grains-sugar beet rotations of the Forest-Steppe of Ukraine[29]. Professor V. I. Moiseienko has established the effectiveness of perennial grasses and their mixtures growing in the fodder crop rotations of the Right Bank Forest-Steppe of Ukraine by means of mineral fertilizers application.

Under the guidance of Professor S. P. Tanchik researchers of the scientific school O. Yu. Karpenko, O. P. Krotinov, Yu. P. Man'ko, V. M. Rozhko have directed their research on the ecological farming model development in the Forest-Steppe of Ukraine. Scientists have published more than 110 scientific works, namely: «Agriculture» (1996), «Agriculture with the basics of soil science and agrochemistry» (2007), «Adaptive systems of agriculture» (2007)[30]. Over 80 Candidates and Doctors of sciences have been trained by the science school. At the beginning of XXI century, the scientists have solved the following tasks: development of effective agroecosystems for farms of different forms of ownership; formation of the integrated weeding control system for crops in different agroecosystems; application of modern adaptive farming systems: industrial, ecological, biological, soil protection and No-till farming system.

A well-known scientific school for the improvement of agro-ecosystems in the Forest-Steppe of Ukraine was established in 1911 at the Myronivs'ka selection and experimental station (now Mironovskyi Institute of Wheat named after V. M. Remesla of NAAS)[31]. From the beginning of its foundation by Professor S. L. Frankfurt, systemic studies were started to determine the effectiveness of application phosphorus oxide fertilizers in winter wheat in grain – beet rotations, namely: superphosphate and basic slag, as well as their aftereffects for sugar beet crops. The closest successor to S. L. Frankfurt's scientific traditions is Professor M. M. Tulaikov. He has determined the efficiency of manure application in grain – fallow crop rotations, improved the use of

[29] Науковий звіт про виконання тематичного плану науково-дослідних робіт агрономічного факультету УСГА за 1962 р. *Центральний державний архів вищих органів влади та управління України.* Ф. Р-27. Оп. 20. Спр. 184. Арк. 1–320.

[30] Мельничук Д. О., Зубець М. В., Беренштейн Л. Ю. Становлення і розвиток аграрної освіти та науки в Україні (з найдавніших часів до сьогодення). Київ: НАУ, 2005. 224 с.

[31] Довідка про науково-дослідні установи сільського господарства Української РСР за 1953 р. *Центральний державний архів вищих органів влади та управління України.* Ф. Р-27. Оп. 18. Спр. 7874. Арк. 1–44.

phosphoric fertilizers: superphosphate and basic slag[32]. Professor O. M. Nadezhdin has introduced into production effective crop rotations with different saturations of sugar beet, winter wheat and rye, which were grown after clear and occupied fallow constantly using mineral fertilizers.

In the first half of the XXth century one of the scientific school's directions was formed by O. K. Filipovskii, who, based on the results of occupied fallow efficiency determination in crop rotations, has established the best early harvesting crops in occupied fallow. Professors I. K. Bobyr, A. I. P'iatenko have identified the effective grain – beet crop rotations with 40–60% saturation of grain crops and 10–40% sugar beet saturation[33]. Professors H. D. Bezvusii, M. H. Hupalo have developed grassland crop rotations to grow perennial grasses, effective alternation of spring barley and wheat in crop rotations, depending on sowing and fertilization methods. V. K. Blazhevskii, S. V. Sukhobrus have recommended for the production a complex of effective agrotechnical measures for corn growing. In the second half of the XXth century, the Academician V. M. Remeslo established the efficiency of winter wheat (variety Myronivs'ka 808) growing in scientifically grounded crop rotations after occupied fallows. The Academician V. F. Saiko has introduced into production the varietal technology and free-field tillage in multiple crop rotations. V. M. Hryniov, M. A. Ilchenko have applied intensive winter wheat (variety Myronivs'ka 808) cultivation technology. V. I. Rusanov, A. M. Tverdokhlib have developed energy-saving, environmentally safe technologies for winter and spring grain crops growing in multiple crop rotations.

At the beginning of the XXIst century the researchers of the scientific school V. P. Kavunets', V. V. Tkalych, O. I. Shevchenko created innovative high-efficient technologies of winter wheat growing of different varieties, winter and spring barley and spring wheat in crop rotations in conditions of the Forest-Steppe of Ukraine. The scientific school has published more than 650 scientific works, namely: «Program of activity of the central experimental station on sugar beet» (1912), «Historical review of the foundation, organization and operation of Myronivs'ka Selection

[32] Миронівський інститут пшениці імені В. М. Ремесла НААН (1912–2012). За ред. В. С. Кочмарського. Миронівка, 2012. 816 с.

[33] Коваленко Н. П. Становлення та розвиток науково-організаційних основ застосування вітчизняних сівозмін у системах землеробства (друга половина XIX – початок XXI ст.) : монографія. Київ: ТОВ «Нілан-ЛТД», 2014. 490 с.

and Experimental Station» (1924), «Myronivs'ka Selection and Experimental Station, its task and labor: the materials of the station's work during 1912–1927» (1927). More than 60 Candidates and Doctors of Sciences have been trained by scientists. At the beginning of the XXIst century the researchers' efforts of the scientific school were aimed at improving the system of different crop rotations and taking into account their intensification and biologization in market conditions. Substantiation of innovative ecologically safe technologies of competitive grain crops growing; the application of complex system of organic and mineral fertilizers in perennial grasses agroecosystems[34].

Significant achievements in improving the grain – row agroecosystems in the Forest-Steppe of Ukraine were obtained by the researchers of the scientific school, which was formed in 1922 at the Research Institute of Selection (now the Institute of Bioenergy Crops and Sugar Beet of NAAS). Since its foundation by Professor V. V. Kolkunov it has been initiated systematic studies on the efficient cultivation of grain crops and sugar beet in grain – beet crop rotations[35]. In the middle of the XXth century the successor of V. V. Kolkunov's scientific traditions Professor M. A. Hrekov identified the value of perennial grasses use in grain – beet crop rotations, as the basis of the grassland system of agriculture[36]. He has published more than 100 scientific works devoted to the development of effective grain – beet crop rotations in the Forest-Steppe of Ukraine. The most significant work among is the book «Beetroot breeding» (1951).

In the second half of the XXth century the closest follower of A. M. Hrekov Professor V. F. Zubenko for the first time has established the economic efficiency of various types of crop rotations, saturated with grains, beans and row crops and revealed the possibility of further intensification of agricultural production. Scientist has published more than 200 scientific works, including recommendations on the effective agricultural crops rotation contained in the book «Scientifically grounded

[34] Миронівський інститут пшениці імені В. М. Ремесла НААН (1912–2012). За ред. В. С. Кочмарського. Миронівка, 2012. 816 с.

[35] Довідка про науково-дослідні установи сільського господарства Української РСР за 1953 р. *Центральний державний архів вищих органів влади та управління України.* Ф. Р-27. Оп. 18. Спр. 7874. Арк. 1–44.

[36] Цвей Я. П., Гоголь Л. О., Кісілевська М. О. Історичний шлях землеробської науки в буряківництві. *Збірник наукових праць Інституту біоенергетичних культур і цукрових буряків.* 2012. Вип. 13. С. 162–169.

system of agriculture in Polissya and Western regions of Ukraine» (1967)[37]. The second follower of M. A. Hrekov's scientific direction Candidate of Sciences I. S. Shkarednii has optimized the placement of crops in grain – beet crop rotations, depending on the tillage and fertilizers.

Valuable achievements of the scientific school are the efficiency determination of grain – beet crop rotations depending on the soil cultivation system, organic and mineral fertilizers use, irrigation, control of saltines and soil erosion, the use of herbicides, polymers, microbiological preparations[38]. Scientists M. A. Hrekov, S. H. Kurbatov have developed and introduced grain – row crop rotations with 30–50% saturation of sugar beets into production. M. F. Derevitskii has developed the methodology and determined ways to improve the accuracy of field experiment. I. V. Yakushkin has improved the classification of crop rotations.

Important achievements of the scientific school, that were developed in the future, were the change establishment of change in the microbial soil cenosis, depending on the presence of biological nitrogen and the use of organic and mineral fertilizers. Scientists I. A. Heller, V. I. Kanivets', A. V. Karbiievs'ka have found that the development of phosphate-mitigating and cellulose-destroying bacteria depended on fertilizer systems, and mushrooms – on the presence of organic fertilizers: manure, straw. The great importance was the problem-solving of nutrients balance regulation in agroecosystems depending on the use of mineral and organic fertilizers and their biologization by such scientists as L. A. Barshtein, V. Ph. Zubenko, V. F. Panchenko, Ya. P. Tsvei, I. S. Shkarednii, V. M. Yakimenko[39]. They determined the effectiveness of agroecosystems biologization methods using grains and white mustard straw as green fertilizer for post-harvest planting.

At the beginning of the XXIst century under Professor Ya. P. Tsvei's guide it has been theoretically substantiated and experimentally determined the scientific and practical aspects of black soils efficient use by means of rational grain–beet crop rotations, soil cultivation, ecological measures of

[37] Коваленко Н. П. Становлення та розвиток науково-організаційних основ застосування вітчизняних сівозмін у системах землеробства (друга половина XIX – початок XXI ст.) : монографія. Київ: ТОВ «Нілан-ЛТД», 2014. 490 с.

[38] Науковий звіт Всесоюзного науково-дослідного інституту цукрових буряків за 1962 р. *Центральний державний архів вищих органів влади та управління України.* Ф. Р-27. Оп. 20. Спр. 183. Арк. 1–72.

[39] Цвей Я. П., Гоголь Л. О., Кісілевська М. О. Історичний шлях землеробської науки в буряківництві. *Збірник наукових праць Інституту біоенергетичних культур і цукрових буряків.* 2012. Вип. 13. С. 162–169.

agroecosystems in the Forest-Steppe of Ukraine. Scientists have established methods for microbiological drugs using and the use of liquid fertilizers and microelements based on chelates. They have substantiated the necessity to use by-products of grain crops on biofuels, depending on the saturation of crop rotation with grains and row crops. Scientists have published the following scientific works, which are of great importance: «Crop rotations in beet-growing areas» (1969), «Agrotechnical bases of crop rotations» (1978), «Crop rotations are the basis of agriculture intensification» (1985), «The system of agriculture in beet growing» (1997) «Transformation of humus in different systems of agriculture» (1997), «Crop rotations, tillage and fertilization in beet-growing zones» (2002)[40]. Over 70 Candidates and Doctors of Sciences have been trained by the scientific school. At the beginning of the XXIst century the scientific school has intensified research in the following areas: substantiation of different crop rotations biologization, taking into account their saturation with grains and row crops; development of methods for soil cultivation minimization in short-term crop rotations; the establishment of the microbiological soil cenosis formation dependence on the fertilization and tillage system in the agroecosystems of the Forest-Steppe of Ukraine.

CONCLUSIONS

It can be concluded that the scientific schools that carried out research work in various soil – climatic conditions of the Forest-Steppe of Ukraine have made a substantial contribution to the development of research and effective introduction of national agroecosystems of different specializations. It has been clearly marked in their activities the main scientific theories and concepts genesis, traditions of scientific creativity, continuity of generations. It has been established that the main centers of their formation were the departments of higher education institutions and laboratories of research institutes, which played the role of leading centers for the development, accumulation and promotion of scientific knowledge about agroecosystems of various specializations.

On the basis of the system historical approach, a number of branch scientific schools for agroecosystems improvement for specialized farms located in different soil-climatic conditions of the Forest-Steppe of Ukraine

[40] Коваленко Н. П. Становлення та розвиток науково-організаційних основ застосування вітчизняних сівозмін у системах землеробства (друга половина XIX – початок XXI ст.) : монографія. Київ: ТОВ «Нілан-ЛТД», 2014. 490 с.

have been allocated. In particular, two scientific schools of grain specialization and three – grain-row, which were widely developed in the second half of the XIXth and early XXth centuries, due to the early development of these areas in agriculture. Researchers of the scientific schools have carried out economic, energy and environmental justification of agroecosystems using the systems of differentiated soil tillage, organic and mineral fertilizers and integrated protection of crops from weeds, diseases and pests. Scientists have developed different crop rotations system taking into account their intensification and biologization in market conditions for farmlands of different specialization. They have also determined the optimal ratio of high-yield crops, best precursors and return periods to the previous place of cultivation. It has been theoretically and methodologically substantiated the use of herbicides, growth regulators, microbiological preparation, liquid fertilizers and microelements in highly productive agroecosystems, methods of their biologization using straw of grain crops, post-harvesting and post-mowing crops.

SUMMARY

It has been established that at the beginning of the XXIst century the development of the agrarian sector of Ukraine was ensured by the effective agroecosystems introduction. They were based on the use of scientifically grounded structure of cultivated areas and specialized crop rotations with efficient alternation of different biological crop groups, rational fertilization and cultivation systems application, as well as environmentally safe measures. With their introduction, important practical tasks were solved in two directions: the reproduction of soil fertility and natural environment preservation, as well as providing the population of Ukraine with high-quality food.

For this purpose the peculiarities of branch scientific schools' activities on agroecosystems improvement for specialized farmlands located in different soil-climatic conditions of the Forest-Steppe of Ukraine have been determined in the article on the basis of the system historical approach. In particular, two scientific schools of grain specialization and three – grain-row, which were widely developed in the second half of the XIXth and early XXth centuries, due to the early development of these areas in agriculture. It has been determined that the precondition for their creation was theoretical knowledge accumulation, the availability of full

value perspective research program, which was possible only with the establishment of branch higher educational institutions and research centers network.

In order to optimize agroecosystems the researchers of the scientific schools have economically, energetically and ecologically substantiated the application of intensive ecological measures for farmlands of different specialization taking into account their intensification and biologization in market conditions. It has been determined the effective crop rotations, the application of differentiated tillage systems, organic and mineral fertilizers and integrated protection, that has contributed to the soil fertility increase and agroecosystems productivity in different soil-climatic zones of Ukraine.

REFERENCES

1. Бойко П. І. Біологічна та екологічна роль сівозмін у землеробстві. Київ: Знання, 1990. 48 с.
2. Бойко П. І., Блащук М. І., Демиденко О. В. Сівозміни та родючість чорнозему Лівобережного Лісостепу : монографія. Сміла, 2019. 450 с.
3. Бойко П., Данилевский А. Координационное совещание. *Земледелие.* 1973. №10. С. 79.
4. Діденко В. В. Нарис історії Національного аграрного університету (до 100-річчя заснування). Київ: Аграрна наука, 1998. 175 с.
5. Довідка від 30 грудня 1964 р. в ЦК КПУ про заходи з підвищення культури землеробства. *Державний архів м. Київ.* Ф. Р-1331. Оп. 3. Спр. 4515. Арк. 1–24.
6. Довідка про науково-дослідні установи сільського господарства Української РСР за 1953 р. *Центральний державний архів вищих органів влади та управління України.* Ф. Р-27. Оп. 18. Спр. 7874. Арк. 1–44.
7. Звіт про науково-дослідну роботу Інституту землеробства УААН за 2001–2005 рр. *Науковий архів ННЦ «Інститут землеробства НААН»*. Оп. 2. Спр. 938. Арк. 1–364.
8. Звіт про науково-дослідну роботу Українського науково-дослідного інституту землеробства за 1986–1990 рр. *Науковий архів ННЦ «Інститут землеробства НААН».* Оп. 2. Спр. 839. Арк. 1–501.

9. Карасюк І. М., Замаховська М. Ю. Уманська сільськогосподарська академія (1884–1999). Київ: Сільгоспосвіта, 1999. 47 с.

10. Коваленко Н. П. Становлення та розвиток науково-організаційних основ застосування вітчизняних сівозмін у системах землеробства (друга половина XIX – початок XXI ст.) : монографія. Київ: ТОВ «Нілан-ЛТД», 2014. 490 с.

11. Мельничук Д. О., Зубець М. В., Беренштейн Л. Ю. Становлення і розвиток аграрної освіти та науки в Україні (з найдавніших часів до сьогодення). Київ: НАУ, 2005. 224 с.

12. Микулинский С. Р., Ярошевский М. Г. Школы в науке. Москва: Наука, 1977. 523 с.

13. Миронівський інститут пшениці імені В. М. Ремесла НААН (1912–2012). За ред. В. С. Кочмарського. Миронівка, 2012. 816 с.

14. Науковий звіт Всесоюзного науково-дослідного інституту цукрових буряків за 1962 р. *Центральний державний архів вищих органів влади та управління України.* Ф. Р-27. Оп. 20. Спр. 183. Арк. 1–72.

15. Науковий звіт про виконання тематичного плану науково-дослідних робіт агрономічного факультету УСГА за 1962 р. *Центральний державний архів вищих органів влади та управління України.* Ф. Р-27. Оп. 20. Спр. 184. Арк. 1–320.

16. Науковий звіт Українського науково-дослідного інституту землеробства за 1965 р. *Центральний державний архів вищих органів влади та управління України.* Ф. Р-27. Оп. 21. Спр. 34. Арк. 1–274.

17. Науковий звіт факультету ґрунтознавства і агрохімії УСГА за 1962 р. *Центральний державний архів вищих органів влади та управління України.* Ф. Р-27. Оп. 20. Спр. 191. Арк. 1–309.

18. Онопрієнко В. І., Ткаченко В. М. Історія української науки. Київ, 2010. 652 с.

19. План і звіт про науково-дослідну роботу кафедри загального землеробства УСГА за 1970 р. *Державний архів м. Київ.* Ф. Р-1331. Оп. 11. Спр. 161. Арк. 1–169.

20. Храмов Ю. А. История формирования и развития физических школ на Украине. Киев: Феникс, 1991. 216 с.

21. Цвей Я. П., Гоголь Л. О., Кісілевська М. О. Історичний шлях землеробської науки в буряківництві. *Збірник наукових праць*

Інституту біоенергетичних культур і цукрових буряків. 2012. Вип. 13. С. 162–169.

22. Юркевич Є. О., Коваленко Н. П., Бакума А. В. Агробіологічні основи сівозмін Степу України : монографія. Одеса: Одеське видавництво «ВМВ», 2011. 240 с.

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