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RESEARCH ASSESSMENT OF THE QUALITY A LEGUMES BY ECONOMIC AND VALUE INDICATORS

VIKTOR MAZUR, *Candidate of Agricultural Sciences, Professor, Vinnytsia National Agrarian University*
HANNA PANTSYREVA, *Candidate of Agricultural Sciences, Associate Professor, Vinnytsia National Agrarian University*
MAKSYM HONCHAR, *Graduate student Vinnytsia National Agrarian University*

The article analyzes global climate changes, which lead to a decrease in the sustainable production of agricultural products, as well as increased attention of the world community to the problems of ensuring food security, which requires innovative approaches to adapting agribusiness to new operating conditions. It has been established that the International Food and Agriculture Organization of the United Nations (FAO) is currently actively implementing a strategic action plan for the adaptation of agriculture to climate change, which is based on the reorientation of agro-food systems in the direction of innovative and mostly carbon-neutral climate-optimized agribusiness. It has been proven that the current trends in increasing prices for mineral fertilizers and energy carriers encourage the search for technologies for the cultivation of leguminous crops, which combine effective agrobiological measures to optimize their nutrition through the use of inoculation, a line of modern microfertilizers and their combinations, taking into account the critical phenological stages of plant development. which ultimately guarantees the realization of both the adaptive potential of the culture and the productive potential of its varieties. It is for these reasons that the scientific substantiation and development of measures to optimize lentil nutrition in the complex of modern agrotechnological methods of its cultivation in the conditions of the right-bank forest-steppe, aimed at ensuring a stable level of productivity with the preservation of quality indicators under the conditions of modern trends towards unstable moisture supply against the background of increasing average daily temperatures, is an urgent task. which requires scientific generalization and solution. The article provides an assessment of the quality of the grain of leguminous crops and highlights their main economic and value indicators, which are regulated by current standards. The assortment of leguminous crops, as well as their importance for the agricultural production of Ukraine, is presented. The issue of harmonization of the main regulatory documents regarding grain and leguminous crops with the requirements of the European Union for a more effective entry of Ukraine into the European and world markets has been studied. Analyzes of certification of grain and leguminous crops were carried out. The validity period of the certificate attesting the sowing quality of seeds has been determined. The concept of quality from the point of view of the consumer of legumes and their processing products is singled out, which is closely related to the aspect of their safety for the consumer's health. The scientific rationale for the development of measures to optimize modern agrotechnological methods of cultivation in the conditions of the right-bank forest-steppe, aimed at ensuring the stability of quality indicators against the background of increasing average daily temperatures, is provided.

Key words: quality, productivity, economic value indicators, legumes, protein.
Table 3. Lit. 20.

Formulation of the problem. Climate change and guaranteeing Ukraine's food security require the cultivation of leguminous crops, among which soybeans, beans, peas, chickpeas, lentils, and lupins play an important role. Modern trends in increasing prices for mineral fertilizers and energy carriers encourage the search for such cultivation technologies, which combine effective agrobiological measures to optimize its nutrition due to the use of inoculation, a line of modern microfertilizers and their combinations, taking into account the critical phenological stages of plant development, which ultimately guarantees the implementation both the adaptive potential of crops and the genetic potential of its varieties. It is for these reasons that the scientific substantiation and development of measures to optimize modern agrotechnological methods of growing in the conditions of the of the Right-Bank Forest-Steppe, aimed at ensuring the stability of quality indicators against the background of increasing average daily temperatures, is an urgent task that requires scientific generalization and solution [1, 10].

Analysis of research and publications. The production of legumes contributes to the stabilization of the country's food security [1]. Leguminous crops in the modern practice of guaranteeing food security are becoming more and more important [2]. The high level of balance of the processing products obtained from them in terms of the content of essential amino acids, many vitamins, folic acid and other biologically active components characterize these crops as indispensable in the formation of food security in the region of their cultivation [3, 4].

At the same time, leguminous crops have a number of advantages over traditional grain crops of the temperate region of Ukraine: a short growing season, a high positive response to the improvement of moisture conditions, fertilization and optimization of the feeding area, the absence of common phytophages with a number of grain crops, and high nutritional value and the value of its leaf-stem mass opens opportunities for sidereal application of these crops [1, 3, 4].

Leguminous crops play an important role in improving soil fertility. They are characterized by an exceptionally valuable ability to bind free air nitrogen with the help of nodule bacteria and enrich the soil with nitrogenous compounds [14]. After the collection of leguminous crops, 20-70 c ha^{-1} of root and harvest residues, which contain 45-130 kg of nitrogen, 10-20 kg of phosphorus and 20-70 kg of potassium, remain in the soil on 1 ha [15]. Nitrogen from root and harvest residues of leguminous crops is practically not washed away, as it is mineralized gradually [9]. Cultivation of legumes in crop rotation ensures the growth of the harvest of other crops and significantly improves its quality. At the same time, they improve biological processes in the soil due to the favorable chemical composition of root and post-harvest residues. At the same time, optimal biological processes are created in the soil, which increase the enzymatic activity and the ability of the following crop rotation to use poorly soluble nutrients. The active activity of nodule bacteria in combination with biological processes improves the nitrogen balance of the soil, which significantly increases its fertility [16]. Increasing the area of leguminous crops is a component of the greening of agriculture [18].

According to the duration of the life cycle, legumes belong to annual (monocarpic) plants [14]. The group of grain legumes includes peas, lentils, beans, chickpeas, soybeans, chickpeas, fodder beans, lupins, mung beans, peanuts, and cowpeas. All of them belong to the legume family (Fabaceae). Currently, peas are one of the most common leguminous crops. In world agriculture, it is grown on all continents of the globe. However, among leguminous crops, soybean stands out as a high-protein and high-oil crop [15, 16, 17, 18]. However, in Ukraine in recent years, niche legumes occupy a larger area due to better adaptation to sharp fluctuations in weather conditions, especially rather uneven distribution of rainfall and unstable soil moisture during the growing season [10].

Therefore, for the most effective use of the agrotechnological potential of legumes, it is important to develop adaptive technologies for its cultivation, which, taking into account the soil and climatic features of the region, ensured the maximum realization of the genetic potential of their varieties.

According to Article 15 of the Law of Ukraine «On Seeds and Planting Material», seeds and planting material are put into circulation after their certification. Certificates for seeds or certificates for planting material can be issued if: seeds and/or planting material belong to a variety entered in the Register of Plant Varieties of Ukraine; the seeds meet the requirements of the legislation in the field of seed production and nurseries in terms of varietal or sowing qualities; planting material in terms of varietal or commercial qualities meets the requirements of the legislation in the field of seed production and nursery production.

In accordance with Article 18 of the Law of Ukraine «On Seeds and Planting Material», the subjects of issuing certificates certifying the varietal qualities of seeds or planting material are the central body of the executive power, which ensures the formation and implementation of the state agrarian policy, or compliance assessment bodies, included in the scope of its management, currently it is the SE «State Center for Certification and Examination of Agricultural Products» [10, 19].

The subjects of issuing certificates certifying the sowing quality of seeds or the marketable quality of planting material are the central body of the executive power, which ensures the formation and implementation of the state agrarian policy, or the bodies for assessing the conformity of any form of ownership. In accordance with Article 181 of the Law of Ukraine «On Seeds and Planting Material», the conformity assessment body has the right to carry out conformity assessment activities in the field of seed production and nurseries only on the condition that it is authorized by the central body of the executive power, which ensures the formation and implementation of the state agrarian policy.

To date, these are the «State Center for Certification and Examination of Agricultural Products» and the departments for determining the sowing qualities of seeds and marketable qualities of planting material of the «Regional Phytosanitary Laboratories» of the «Regional Phytosanitary Laboratories», which received a certificate on the determination of technical competence, which certifies that it meets the requirements of DSTU ISO 10012: 2005 and ensures technical competence in carrying out measurements, and issues a «Test Report» [10].

In Ukraine, the following types of certificates have been put into effect, which confirm the compliance of seed varieties and sowing qualities with the requirements of state and industry standards: variety identification certificate, certificate for grain, leguminous, fodder, oil, essential oil, technical, flower, vegetable, hospital crops and sugar seeds beet; potato seed certificate. Certificates are issued for seeds that meet the requirements of state and industry standards in terms of varietal and seed quality. Certification bodies in Ukraine are regional, district, state seed inspections, as well as non-commercial associations, unions, organizations registered in accordance with the established procedure, accredited and licensed in accordance with the procedure established in the System. The main functions of certification bodies: seed certification, issuance of certificates and their accounting, accreditation of state seed inspections and organizations as testing laboratories, implementation of inspection control over their activities, etc. According to international practice, the certification process includes: submitting an order for certification, reviewing the order and making a decision; control over compliance with standards and other regulatory documentation in the production, packaging and sale of seeds; carrying out varietal identification; sampling for testing; analysis of the received materials and decision-making on the possibility of issuing a certificate and carrying out inspection control of certified seeds [19].

General quality management (quality assurance) is one of the most important principles of the functioning of processing enterprises. In Ukraine, the spread of the TQM philosophy took place in the application of the ISO 9000 series international standards, which incorporated the main experience of the international community in creating competitive entrepreneurship. The widespread use of international standards of the ISO 9000 series around the world confirms the effectiveness of the implementation of quality management systems in accordance with these standards.

Scientifically oriented aspects of the basics of the production of leguminous crops with the preservation of quality indicators are highlighted in the works of Ukrainian and foreign scientists. Issues in the field of increasing the productivity of grain and leguminous crops are covered in the works of V. Mazur, V. Petchichenko, H. Pantsyreva, M. Bakhmat, O. Chinchyk, V. Kaminsky, O. Ovcharuk, and others. [2, 3, 4, 8, 20]. Economists H. Kaletnik, I. Honcharuk, and K. Mazur investigated the issue of efficient production and market development of agricultural products, including grain and leguminous crops [13, 19]. The theoretical, methodological, methodical and applied principles of grain production are given in the works of V. Petrichenko, H. Zabolotny, V. Kaminsky, and others. [2, 8, 9].

The purpose of the research was to determine the regularities of the formation of grain quality indicators of leguminous crops. According to the goal, the main tasks were: to investigate the dynamics of changes in the production of legumes; determine the priority crops in the structure of the production of legumes in the world space; to carry out an analysis of the yield level of niche leguminous crops in order to identify the amplitude of their changes over the years; to determine the main indicators of the quality of grain and leguminous crops for the vector orientation to guarantee the food security of Ukraine.

Research material and methods. The informational niche of the scientific article was legal acts, analytical materials of international organizations, information from the Ministry of Agrarian Policy and Food of Ukraine, the Ministry of Economic Development, Trade and Agriculture of Ukraine, official publications of the State Statistics Service of Ukraine, scientific publications of foreign and domestic scientists, statistical reporting materials of Ukrainian grain producers and grain traders, data and assessment of independent experts, results of own research and calculations of the team of authors.

In the process of conducting research, collecting, systematizing and processing the obtained research data, the following methods were used: statistical, dispersion, cluster, calculation-comparative.

The conducted research is strengthened by the conducted applied research on the topic: «Development of methods of improving the technology of growing legumes using biofertilizers, bacterial preparations, foliar feeding and physiologically active substances» under the leadership of Professor V. Mazur. (main performers I. Didur, O. Tkachuk, H. Pantsyreva).

Research results and their discussion. According to UN FAO data, global climate changes have been manifested in recent decades with an increase in average annual air temperatures, on the European continent such changes are most significant in Belarus, Poland and Ukraine - up to 1.9oC per year. Scientists predict that in the future climate changes will have a significant impact on agriculture in various countries of the world. At the same time, the biological properties of various agricultural crops, crop rotation, cultivation technology, as well as agricultural management systems as a whole have their peculiarities [19-20].

Research by the European Environment Agency found that, starting from 1960, every ten years the amount of precipitation in Northern Europe increased by 70 mm, while in the South, on the contrary, it decreased by 90 mm. Such changes are the most important factor in agricultural productivity. It is predicted that in Central and Eastern Europe, the amount of torrential rain that reduces yields may increase by 35%. On the other hand, the increase in temperature and drought in the south of the European continent will lead to the loss of crop production and cause the need for a significant increase in the area of leguminous crops such as soybeans, chickpeas, lupins, and lentils [5].

The natural conditions of the Right-Bank Forest-Steppe are favorable for growing high-quality grain. Also, it should be noted that in recent years, Ukraine has been confidently asserting itself on the global grain market, but its quality sometimes does not meet global standards. Grain production, due to a number of factors, has been accompanied by a noticeable deterioration in its quality in recent years, primarily by a decrease in grain protein, gluten content and quality. Cultivation of grain that would meet the requirements of world quality standards is a primary task facing agricultural science. It is important to coordinate productivity and quality indicators of leguminous crops with economic and energy indicators [10].

Therefore, the development of innovative technologies for the production of high-quality grain in the conditions of the Right-Bank Forest-Steppe on the basis of resource conservation, biologicalization and environmentalization is relevant.

In world agriculture, legumes occupy an area of more than 100 million hectares (Table 1).

Table 1

World production of leguminous seeds

Culture	Sown areas, million ha				Productivity, t ha^{-1}			
	2000	2015	2020	2022	2000	2015	2020	2022
Bean	23,7	30,4	35,5	34,5	0,75	0,89	0,89	0,85
Chickpeas	10,3	13,6	16,6	16,8	0,79	0,96	0,97	1,03
Pea	6,0	6,8	8,1	7,9	1,78	1,72	2,01	1,72
Lentil	3,9	4,0	6,6	6,1	0,87	1,17	1,25	1,05
Lupine	1,3	0,7	0,9	1,0	0,93	1,51	1,63	1,23

Source. Own calculations of the team of authors based on research and analysis of information of the State Statistics Service.

Soy (more than 50 million hectares), beans (34,5 million hectares), chickpeas (16,8 million hectares) and peas (8,1 million hectares) occupy the largest area among legumes. Among agricultural crops, legumes have the highest protein content. Grain and green mass of leguminous crops contain 1.5-3 times more protein than cereals, which makes it possible to obtain the highest yield of digestible protein and essential amino acids per hectare of sowing. It is also important that their proteins are complete in terms of amino acid composition and are much better absorbed by the body than the proteins of cereal crops. Grain legumes, due to the valuable chemical composition of the grain, have great industrial and raw material value.

Considering these facts, legumes are rich in various trace elements and have a positive effect on the general immunity of the entire human body (Table 2).

Table 2

The content of trace elements in the seeds of legumes (mg/100 g)

Culture	Fe	Mg	P	K	Zn	Cu
Bean	4,6	129	381	1240	5.02	1.09
Chickpeas	6,6	132	264	819	3.12	0.44
Pea	4,5	142	309	944	3.32	0.24
Lentil	7,1	66	231	752	3.55	0.41
Lupine	6,0	213	502	1030	5.22	0.67

Source. Own calculations of the team of authors based on research and analysis of information of the State Statistics Service.

It is noted [16, 20] that 100 grams of leguminous seeds contain on average: 309–337 kcal. Legume seed protein is 90% soluble in water and NaCl solution, so it is easily absorbed by the human and animal body (Table 3). The ability of leguminous crops to low accumulation of nitrates, nitrites and radionuclides is also positive, which makes them indispensable for use in the system of organic agriculture and crop production.

Table 3

Indicators of the nutritional value of legumes (g/100 g)

Culture	Energy, kcal	White	Fat	Food fibers	Carbohydrates
Bean	318	20.5	0.6	13.1	51.3
Chickpeas	337	20.4	5.2	20.7	42.0
Pea	310	23.4	2.1	22.2	38.4
Lentil	324	24.4	1.5	17.0	44.8
Lupine	309	34.1	6.5	35.3	10.8

Source. Own calculations of the team of authors based on research and analysis of information of the State Statistics Service.

According to the biochemical composition, legume seeds are among the leaders in dietary nutrition with a high bioprotective effect and a high content of vitamins of the biological group.

Legumes can be used to prevent deficiency of both protein and amino acids, especially lysine [2]. Also, leguminous crops, along with providing valuable food products and fodder, should be of decisive importance in phytoremediation, phytosanitary cleaning of the soil, as well as in reducing costs in crop production [16 20]. An important source of growth in the production of competitive plant products in the system of sustainable agriculture is an increase in the specific mass of leguminous crops in the structure of sown areas, due to their ability to symbiotic fixation [11]. The introduction of scientifically based crop rotations of leguminous crops can serve as an important factor in the intensification of agriculture, which ensures the rational use of biological and mineral nitrogen, the reduction of energy consumption and the improvement of the ecological state [11, 13, 14].

Conclusions. The natural and climatic conditions and natural fertility of the lands of Ukraine contribute to the cultivation of all grain and leguminous crops, ensuring the receipt of significant volumes of high-quality grain, capable of covering not only internal but also external needs. In world agriculture, legumes occupy an area of more than 100 million hectares. Soy (more than 50 million hectares), beans (34,5 million hectares), chickpeas (16,8 million hectares) and peas (8,1 million hectares) occupy the largest area among legumes. In view of this, the further development of the industry requires a review of a number of positions regarding the technical-technological, organizational and economic components of growing legumes.

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АНОТАЦІЯ
ОЦІНКА ЯКОСТІ ЗЕРНА ЗЕРНОБОБОВИХ КУЛЬТУР ЗА ГОСПОДАРСЬКО-ЦІННИМИ ПОКАЗНИКАМИ

У статті проаналізовано глобальні кліматичні зміни, що призводять до зниження сталого виробництва аграрної продукції, а також посилення уваги світової спільноти до проблем забезпечення продовольчої безпеки, що вимагає інноваційних підходів адаптації агробізнесу до нових умов діяльності. Встановлено, що Міжнародна організація із сільського господарства та продовольства ООН (FAO) нині активно впроваджує стратегічний план дій з адаптації сільського господарства до зміни клімату, який базується на переорієнтації агропродовольчих систем у напрямі інноваційного й здебільшого вуглецево нейтрального кліматично оптимізованого агробізнесу. Доведено, що сучасні тенденції підвищення цін на мінеральні добрива та енергоносії спонукають до пошуку таких технологій вирощування зернобобових культур, у яких поєднуються ефективні агробіологічні заходи оптимізації її живлення за рахунок застосування інокуляції, лінійки сучасних мікродобрив та їх комбінації з огляду на критичні фенологічні стадії розвитку рослин, що у підсумку гарантує реалізацію як адаптивного потенціалу культури, так і урожайного потенціалу її сортів. Саме з цих причин наукове обґрунтування і розробка заходів оптимізації живлення сочевиці у комплексі сучасних агротехнологічних прийомів її вирощування в умовах Лісостепу правобережного, спрямованих на забезпечення сталого рівня врожайності із збереженням показників якості за умов сучасних тенденцій до нестабільного вологозабезпечення на тлі підвищення середньодобових температур є завданням актуальним, яке потребує наукового узагальнення та вирішення. У статті наведено оцінку якості зерна зернобобових культур та виокремлено основні їх господарсько-цінні показники, що регламентуються чинними стандартами. Наведено асортимент зернобобових культур, а також їх значення для сільськогосподарського виробництва України. Досліджено питання гармонізації основних нормативних документів щодо зернобобових культур, з вимогами Європейського союзу для більш ефективного входження України на Європейський та світовий ринки. Здійснено аналітику сертифікації зерна і насіння зернобобових культур. Визначено строки дії сертифіката, що засвідчує посівні якості насіння. Виокремлено поняття якості з точки зору споживача зернобобових культур та продуктів їх переробки, що тісно пов'язано з аспектом їх безпечності для здоров'я споживача. Приведено наукове обґрунтування розробки заходів оптимізації сучасних агротехнологічних прийомів вирощування в умовах Лісостепу правобережного, спрямованих на забезпечення сталості показників якості на тлі підвищення середньодобових температур.

Ключові слова: *якість, врожайність, господарсько-цінні показники, зернобобові культури, білок.*

Табл. 3. Літ. 20.

Інформація про авторів

Мазур Віктор Анатолійович – кандидат сільськогосподарських наук, професор кафедри рослинництва, селекції та біоенергетичних культур, ректор Вінницького національного аграрного університету (21008, вул. Сонячна, 3, e-mail: rector@vsau.org).

Панцирева Ганна Віталіївна – кандидат сільськогосподарських наук, провідний науковий співробітник, доцент кафедри лісового, садово-паркового господарства, садівництва та виноградарства Вінницького національного аграрного університету (21008, м. Вінниця, вул. Сонячна 3, e-mail: apantsyreva@ukr.net).

Гончар Максим Васильович – аспірант першого року навчання кафедри лісового, садово-паркового господарства, садівництва та виноградарства Вінницького національного аграрного університету (21008, м. Вінниця, вул. Сонячна 3, e-mail: Spider2210@ukr.net).

Mazur Viktor – Candidate of Agricultural Sciences, Professor of the Department of Plant Growing, Selection and Bioenergetic Cultures, Rector of the Vinnytsia National Agrarian University, Vice-President of ESPC Ukrainian Scientific-Educational Consortium (21008, Vinnytsia, Soniachna Str.3, e-mail: rector@vsau.org).

Pantsyreva Hanna – Candidate of Agricultural Sciences, leading researcher, Associate Professor of the Department of Landscape Management, Forestry, Horticulture and Viniculture of Vinnytsia National Agrarian University (21008, Vinnytsia, Soniachna Str. 3, e-mail: apantsyreva@ukr.net).

Maksym Honchar – postgraduate student of the first year study of the Department of Landscape Management, Forestry, Horticulture and Viniculture of Vinnytsia National Agrarian University (21008, Vinnytsia, Soniachna Str. 3, e-mail: Spider2210@ukr.net).