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The collective monograph describes the integration of traditional and innovation processes of development of modern science. The general issues of the biological sciences, engineering and technical support and AIC management, information, computing, and automation, etc. are considered. The publication is intended for scholars, teachers, postgraduate students, and students, as well as a wide readership.

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CHAPTER «AGRICULTURAL SCIENCES»

EFFICIENCY OF GROWING LEGUMES CROPS IN UKRAINE

Inna Honcharuk¹
Hanna Pantsyreva²

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Abstract. The research presented in the monograph is aimed at solving current socio-environmental problems of Ukraine, as well as the implementation of priority areas of sustainable development, namely energy efficiency and environmental safety, which will be provided through the development and implementation of the latest concept of environmentally sound and energy efficient rural development. The implementation of environmentally friendly direction will involve the development of measures for efficient waste management, rational use of bioresources by increasing the area and volume of energy crops, as well as improving cultivation technologies, use of new varieties and hybrids and land reclamation, taking into account the concepts of environmental management. Implementation of the proposed measures for energy efficient development of rural areas will involve the formation of technical and technological basis for the use of waste and processing of organic raw materials for energy purposes, development of energy cooperation, land use optimization, biologization of agriculture. The monograph presents a competitive bioorganic varietal technology for growing legumes, which provides for the development of regulations for the use of a set of alternative fertilizers for their cultivation in terms of short-term and long-term action and the basic superstructure of factor assessment of soil fertility, ecological conditions. The scientific and methodological value of the monograph lies in the presentation of the results

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of research conducted on the basis of the Research Farm «Agronomiche» of Vinnytsia National Agrarian University, Agronomichne village, Vinnytsia district, Vinnytsia region. Scientific substantiation of technological methods of growing legumes allows to modernize the system of training of future specialists in the field of agrotechnologies and to increase the production and practical orientation of such professional training.

1. Introduction

Protein economy plays a key role in the state's economy. To ensure the efficient operation of the protein economy, it is important to fully meet the country's domestic needs in legumes and increase the volume of possible exports. For Ukraine, increasing grain production is of strategic importance for the rise of the national economy, because its successful development creates conditions for the effective operation of a number of related industries. To ensure the efficient operation of the protein economy, it is important to fully meet the country's domestic grain needs and increase possible exports.

An actual and effective way to increase the efficiency of crop production now and in the near future perspective will be the use of the latest advances in science in the biological, technological and information fields.

In modern conditions of agricultural production, the priority area of research is the justification and improvement of modern agricultural technologies for growing legumes on the basis of energy and resource conservation and environmental safety. In this regard, special attention should be paid to legumes, which have important fodder, agronomic, economic importance.

Natural and climatic conditions of our state are favorable for growing all known cereals and legumes. Combined with the high agricultural skills of the Ukrainian peasantry, this led the country at the end of the last century to one of the leading places in Europe for the production of high quality grain for various purposes. It was famous as one of the largest and most reliable granaries, as well as protein regions. And if today our state, for a number of objective and subjective reasons, is experiencing difficulties in the development of legumes, it should be considered a temporary phenomenon.

Protein production plays a key role in the state's economy. To ensure the efficient operation of the protein economy, it is important to fully meet the

country's domestic protein needs and increase possible exports. For Ukraine, increasing the production of protein from legumes is of strategic importance for the rise of the national economy, because its successful development creates the conditions for the effective operation of a number of related industries. Improving the efficiency of protein production is one of the most important tasks on which the country's food security depends. It should be carried out at both the state and regional levels, where the issues of providing the population with food and livestock with highly nutritious feed are addressed.

Of all crops, legumes contain the most protein. Their grain and green mass in terms of protein content exceeds cereals more than twice, in terms of amino acid composition their proteins are much better digested, give the cheapest protein, include in the biological cycle nitrogen air, which is not available for other crops. Today, vegetable protein is highly valued in the food and feed industry.

Today in Ukraine 325 thousand hectares are sown for legumes and 8325 thousand hectares for oilseeds, 1850 thousand hectares are soybeans. In 2019, 508 thousand tons of legumes, 3.9 million tons of soybeans were produced with yields of 2 t/ha and 1.8 t/ha, respectively.

Strategically, Ukraine must take a course to reduce volumes export of raw materials and creating conditions for the organization in-depth processing, which will contribute to: meeting the needs of intensive animal husbandry with high-protein feed; creation of new jobs; increase in taxes; ensuring food and environmental security of Ukraine.

Intensification of legume production should to become one of the strategic directions of accelerated development of all agro-industrial production of Ukraine for the next 10 years. To do this, it is necessary to focus on the development of cost-effective technologies, namely the creation of high-yielding varieties of legumes of different maturity groups with clarification of the stable production zone, optimization of the sown area of leading crops, development and implementation of science-intensive technologies based on resource saving. In addition, in the context of climate change, it will be necessary to form a common agricultural policy for the production of high-protein feed with the EU. This is an urgent and important task that will be solved significant contribution to solving the problem of vegetable protein, the formation of its own protein resources, increasing soil fertility and strengthening the economy of Ukraine.

2. Analysis of recent research and publications

One of the main branches of material production is agriculture. Crop products are extremely important – one of the leading branches of agricultural production. Over investigate the issue of economic efficiency of legumes such known scientists and economists as Kaletnik G. (2018), Honcharuk I. (2019). Development of technological methods of cultivation, improvement efficiency of legumes use in agriculture, as well as its selection and biology in Ukraine were engaged in such scientists as Babych A. (1993), Petrychenko V. (2014), Chynchyk O. (2019), Kalenska S. (2015), Cherenkov A. (2016), Bakhmat O. (2018), Pansyryeva H. (2017).

Rational use of nature, development of rural areas and issues related to solving current problems of environmentally friendly and energy efficient development have been studied in the works of both domestic and foreign scientists. Thus, G. Hartt and E. Larson explored theoretical approaches to the definition of «rural areas» used in the EU; American scientist K. Johnson, studying the theoretical aspects of rural development, noted that the development of rural areas is associated not only with the development of agriculture, but also with the development of industry and other industries.

The works of Datta A., Hossain A., Roy S., Tiseo I., Uslu A., Detz R., Mozaffarian H. The study of rural development in the context of energy V. Andriychuk, B. Panasyuk, G. Zabolotny, G. Kaletnik, I. Kyrylenko, A. Lisovy, M. Malik and others dedicated their works to environmental protection. In particular, V. Mesel-Veselyak researched the basic principles that should be used in the development of rural development in Ukraine. Sustainable rural development and ecology are closely linked, as confirmed by European research. Thus, in December 2015, the EU Commission paved the way for a resource-saving society and a sustainable economy in Europe. In addition to developing an action plan, it was suggested that key waste legislation be reviewed in order to reduce the generation and reuse and recycling of more waste in the future.

The basis of sustainable development of rural areas is the effective conduct of agriculture. Petrychenko V., Kaminsky V., Patyka V., Babych O., Shevnikov M. devoted their works to the development of ecological and adaptive models of growing crops with ensuring the preservation of high levels of varietal bioproductivity and mobilization of soil fertility conditions

Kots S., Kaminsky V., Bakhmat O., Sherstoboeva O., Elsheikh E., Tagore G., Mishra A. and other.

Technical aspects and problems that arise during the primary processing of organic products are devoted to the works of Nanka O., Ievlevva I., Sementsova V., Boyko D., Kosse V., Mathew J. and many other domestic and foreign scientists. In their research, the authors emphasize the imperfections of traditional methods of impact grinding and determine the positive effect of sharp edges of the hammer on the energy performance of the destruction of organic material.

The research is of considerable scientific interest. However, in the context of Ukraine's European integration and orientation to European standards, further research requires a comprehensive approach to rural development based on the development of the latest concept of environmentally friendly and energy efficient development. The scientific work is focused on achieving a comprehensive effect in ensuring sustainable agro-industrial production while ensuring the necessary levels of food and bioenergy security of the state in order to reproduce soil fertility potential, as well as improving living conditions, public health by increasing access to production and consumption of organic agricultural products.

Thus, the production of legumes occupies a special place among other branches of crop production, because grain is not only the basis of human nutrition, but also is a source of livestock production, an export product that determines the foreign economic position of the state. Despite the fact that our country has good climatic conditions and fertile chernozems for growing legumes, in recent years, feed production has not been stable. Therefore, the primary task of producers of protein crops is to increase the fertility and economic efficiency of legume production. More attention should be paid to achieving highly efficient management, improving the quality of agricultural products. Improving the economic efficiency of agriculture involves increasing production and improving the quality of agricultural products while reducing labor costs and material resources per unit of output. The solution of this problem is inextricably linked with the further comprehensive intensification of agricultural production, in the process of which increases the yield of crops and productivity of livestock and poultry. In modern conditions, agriculture is developing mainly on the basis of intensification, which is the main source of increasing its economic efficiency.

Today, the development and efficient functioning of rural areas in Ukraine should be based on the following priority areas: environmental friendliness, energy saving and alternative energy. The monograph has a socio-environmental and energy focus and focuses on addressing global issues reflected in the Energy Strategy of Ukraine until 2035 «Security, Energy Efficiency, Competitiveness», «On Waste and Repeal of Certain Directives» and the UN Framework Convention on Climate Change, Cabinet Resolution Ministers of Ukraine «On combined heat and power generation (cogeneration) and use of waste energy potential»; will promote the sustainable development of the agro-industrial complex, which is one of the strategic goals of the Draft Strategy for Sustainable Development of Ukraine until 2030.

3. Literature review

The most pressing problems of modern society and rural development include the organization of rational nature management, energy consumption with minimal negative impact on the environment, careful use of energy resources for reasonable and sufficient satisfaction of technological and household needs of citizens in all types and forms of energy.

Currently in the world and in Ukraine an extremely important problem is the development of organic farming, development of environmentally friendly technologies for growing legumes, expanding areas for growing high-protein legumes and studying their impact on soil fertility, improving its condition and preservation in general under climate change. In this regard, it is important to find alternative systems for fertilizing crops, selection of legumes for different areas using microbiological fertilizers and growth stimulants allowed for use, in order to preserve soil fertility, improve its physicochemical properties and particle size distribution, stability of soil development. The system of using domestic biological fertilizers as a factor in increasing competitive agriculture and adapting organic technologies for growing legumes is to be studied.

Growing legumes will increase the attractiveness of the market for organic production due to cheaper basic components of biofertilizers due to the recommendation of domestic counterparts by at least 20-25% while reducing the cost of production in the pre-calculated range by 15-27%. Such a system of purchasing biologicals will stimulate revenues to local

budgets by further expanding the production of recommended biologicals by regional enterprises by at least 8-10%.

In today's conditions, the development of effective models of bioorganic fertilizers of the studied crops in the region with the formulation of basic principles of such fertilizers and guidelines for options for effective use of biological products in both single-component and combined applications is crucial. Improving the technological regulations for the use of biofertilizers in terms of their classification groups – biodestructors, element fixers, biofertilizers, biostimulators of growth, chelated microbiocomplexes can guarantee the effective conduct of sustainable organic production. Also, research has shown that with the related effects of biological products on the relevant soil nutrients, the dynamics of macro-and micronutrients in the soil, its microbiological activity and microbiological potential, especially in soil applications of the studied drugs will increase the overall efficiency of arable land and Ukraine environmental safety of the products and increase the level of environmental sustainability of the region, provide an overall increase in crop productivity by at least 15% while saving production resources by at least 18-27%, promote marketing advantages of domestic producers of organic products and related technological components.

Therefore, the development of effective models of bioorganic fertilizers for legumes in the region with the formulation of basic principles of such fertilizers and guidelines for options for effective use of biological products in both single-component and combined applications is extremely important and requires appropriate scientific justification.

4. Conditions, objective and methods of research

Field experiments were conducted during 2016–2020 on the basis of the Research Farm «Agronomiche» of Vinnytsia National Agrarian University in the village of Agronomichne of Vinnytsia district of Vinnytsia region. The territory of the right-bank Forest-Steppe of Ukraine, the place of research, is characterized by a favorable agro-climatic potential for growing most crops, including legumes. In particular, there are sufficient amounts of active air temperatures and rainfall per year and their distribution over the growing season. However, the real bioclimatic resources of the region are not enough to better realize the productivity potential of legumes. Therefore, there is a need to develop new and improve existing models of

technologies for growing legumes. Clarification of these issues is relevant and requires detailed studies, especially on the development of zonal cultivation technologies, which take into account the specifics of soil and climatic potential of the growing region.

The Forest-Steppe is characterized by a temperate continental climate and belongs to the zone of sufficient moisture. According to meteorological observations, the main indicators of climatic conditions in the years of research were close to the average long-term data, but also revealed deviations that were reflected in the production process of legumes (Figure 1).

The absence of high mountain elevations contributes to the free movement of air of various origins, which causes significant variability of weather processes in certain seasons. The main climatic indicators of the central zone of Vinnytsia region, where they were conducted studies are shown in the table 1.

Vinnytsia district is located in the central part of Vinnytsia region, which is characterized by a moderately warm and humid climate typical of the Right-Bank Forest-Steppe. Hydrothermal coefficient – 1.7-1.8. Average number precipitation is up to 930 mm per year. The highest amount of precipitation (up to 75%) is from April to September. Humidity factor up to 14.

The Right-Bank Forest-Steppe is a zone of temperate zone, which is characterized by alternation of forest and steppe vegetation. Soils are formed under conditions of unstable moisture, in which the podzolic process of soil formation is combined with turf. Plants growing on these soils receive a high amount for the consumption of mobile phosphorus 214 mg / kg and metabolic potassium 104 mg / kg (according to Chirikov). However, the content of easily hydrolyzed nitrogen is very low and is 43.5 mg / kg (according to Cornfield). Gray forest soils occupy an intermediate position between light gray forest and dark gray podzolic soils. As a rule, soil-forming rocks are forests and forest-like loams. They are characterized by coarse-grained medium-loam mechanical composition. The absorbing complex of gray forest soils is saturated with Ca^{2+} , Mg^{2+} and H^{+} . Soils capable of structure formation, prone to swimming, crusting and plowing, susceptible to erosion, are not always characterized by a stable water regime, which in turn reduces their productivity. Gray forest soils have a clearly visible division of their profile into horizons. The research included the study of the

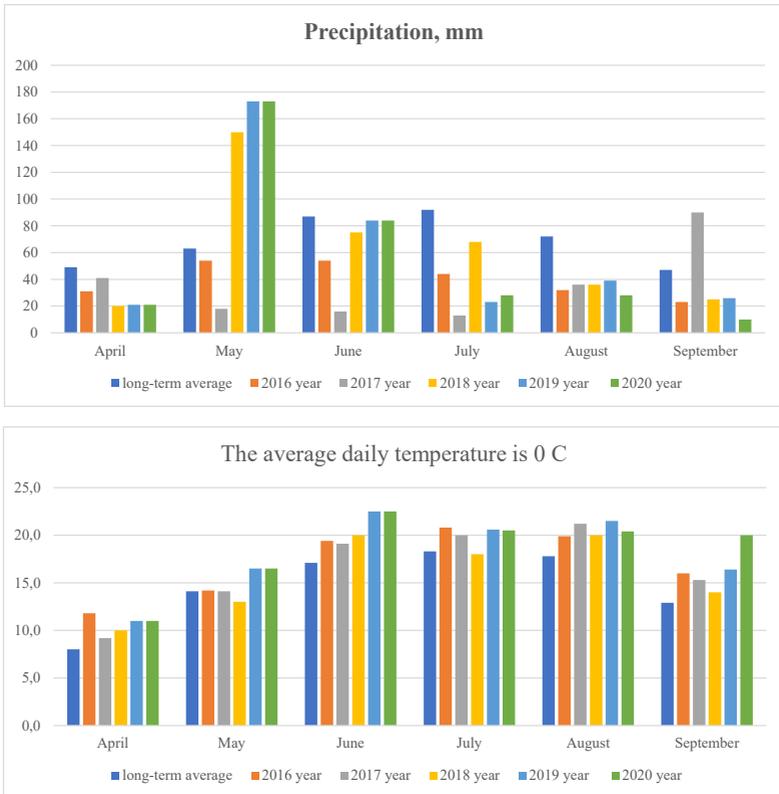


Figure 1. Average daily air temperature and precipitation for 2016–2020 (according to the Vinnytsia Regional Center for Hydrometeorology)

action and interaction of 3 factors: A – grade; B – pre-sowing treatment of seeds with a bacterial preparation; C – is the concentration of the retardant.

The levels of yield of legume seeds grown in the Right Bank Forest-Steppe of Ukraine – soybeans, peas, white lupine and narrow-leaved lupine are given (Figure 2).

Object of research: legumes and the effectiveness of biological fertilizers on their crops and the growth of regulatory substances and their impact on changes in the natural fertility of the soil and its mycosis.

Table 1

Climatic indicators of the central zone of Vinnytsia region

Climatic indicators	Central area
The sum of positive temperatures (more than 0 °C)	2671-2780
Duration of frost-free period (days)	141-147
Average annual air temperature (0 °C)	7,3
The average of the absolute minimums of air temperature (0 °C)	- 25
Absolute maximum air temperature (0 °C)	+38
Average date of the first frost (autumn)	17.09
Average date of the last frost (spring)	24.04
Duration of the growing season (days)	190-215
Average rainfall per year (mm)	930
Precipitation during the growing season (mm)	328
Length of the period with snow cover (days)	86
Average depth of soil freezing (cm)	55
Maximum depth of soil freezing (cm)	84
Minimum depth of soil freezing (cm)	21
The sum of active temperatures (0 °C)	2500
The prevailing wind direction	Northwestern

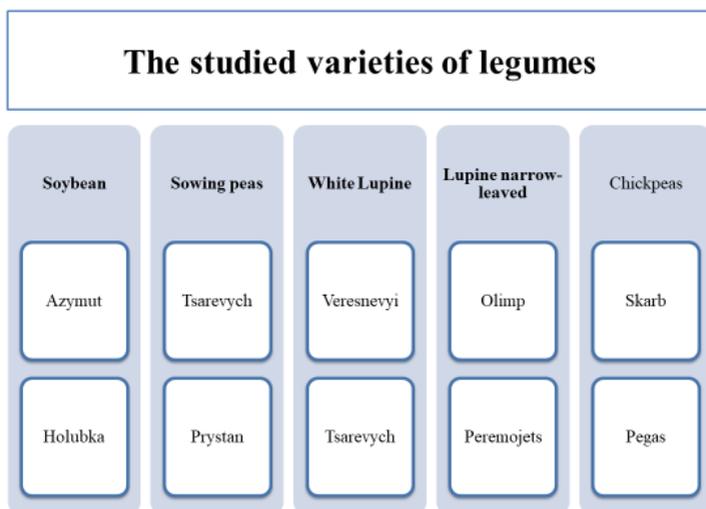


Figure 2. The studied varieties of legumes

Subject of research: increase of productivity of grain legumes and subsequent crops of crop rotation due to application of system of organic fertilizer and growth of regulating substances in technologies of their cultivation, influence on changes of fertility and preservation of soil.

The aim of the study is to develop competitive technologies for growing legumes, which involves the development of elements of application of a set of alternative fertilizers for their cultivation in terms of short-term and long-term action and basic superstructure of factor assessment of soil fertility, hydrothermal conditions, resource provision of enterprises, ecology.

The objectives of the study include:

- formation of a new method of assessing the bioadequate productivity of arable land to determine the possibility of adaptation of the enterprise to bioorganic technologies for growing legumes;

- development of effective regulations for the use of different types of biofertilizers for the growing season by classical types in the system of agrotechnologies for growing legumes;

- development of a system of application of bioorganic agrochemicals in the system of soil use on the basis of mobilization agrochemical approaches;

- development of a comprehensive strategy for the transition to bioorganically adapted varietal technologies for growing basic legumes.

Scientific approaches were used during the research:

- a systematic approach that will allow to consider varietal agricultural technologies as a multi-factor regulated system, which has the main regulated criteria and falls under the natural principles of factorial analysis;

- analytical approach, which involves the use of correlation-regression approaches in the evaluation of optimized technology options, forecasting the development of results and evaluation of the average periodic final results;

- activity approach that will allow to consider the developed models of bioorganic technologies in view of the social factor and demography of the territory in dynamics to the specialization of the relevant agricultural formations and ecological and agrochemical condition of the territory;

- information approach, which is based on a reliable and balanced collection of source data, a comprehensive assessment of the real state of affairs, general collection and systematization of the information obtained with regard to the object of study.

This comprehensive approach will identify effective models of biofertilizer, taking into account the cost of compensating for reduced yields for the abandonment of conventional fertilizers and will predict the positive impact on the soil-plant system in the short and long term given soil conservation.

5. Economic efficiency of technological methods of growing legumes

In modern conditions of agriculture, an important requirement for the elements of technology that are developed and implemented in production is to reduce the unit cost, reduce energy costs, and as a result – increase profits. Modern technologies for growing crops should be developed on the principles of saving money, material and energy resources. In addition, they must be competitive in the technology market.

Energy analysis is important in modern agronomic research. This method is widely used in the United States, Canada, Britain, Australia and other developed countries. Energy analysis of technological elements of growing crops allows you to objectively determine their energy intensity and identify ways to reduce energy consumption.

Technological aspects of growing legumes, along with ensuring a higher level of yield and quality of grain should be characterized by economic and energy indicators that would exceed the control, thereby ensuring the competitiveness and profitability of the products grown.

Varieties, bacterial preparations, growth stimulants, mineral nutrition, crop protection system against pests, diseases and weeds, and other factors play a key role in the components of technological methods that determine the indicators of economic and energy efficiency of growing annual legumes for grain.

The application of the latest scientific developments is accelerating and this allows to obtain higher profits, which increases the production of legumes. That is why the question of the effectiveness of scientific research is very important. However, the economic efficiency of the elements of technology for growing new varieties has not been studied enough. Based on this, there is a need to determine the economic efficiency of each studied element of technology in order to identify the most effective of them.

It is established that the studied elements of cultivation technology significantly influenced the indicators of economic efficiency of growing legumes (Table 2).

Table 2

Economic efficiency of cultivation legumes (average for 2016–2020)

№	Culture	Variety	Pre-sowing seed treatment	Retardant concentration, %	Yield, t/ha	Cost, dollars / t	Relatively net profit, dollars / ha	Profitability level, %
1	Sowing peas	Tsarevych	without p.s.t.	without treatment (C)	2,05	75,22	185,75	72
			Rhyzogumin	0,5	2,14	71,42	203,57	78
				0,75	2,53	71,88	214,28	82
		Prystan	without p.s.t.	without treatment	2,46	67,85	235,71	91
			Rhyzogumin	0,5	2,15	75,17	186,89	72
				0,75	2,25	71,46	203,64	78
2	White lupine	Veresnevyi	without p.s.t.	without treatment (C)	2,54	68,64	235,45	91
			Rhyzogumin	0,5	2,74	138,89	402,28	101
				0,75	2,94	133,57	438,92	107
		Chabanskyi	without p.s.t.	without treatment	3,07	138,78	456,07	108
			Rhyzogumin	0,5	2,88	141,14	457,85	102
				0,75	3,05	138,77	487,85	106
3	Lupine narrow-leaved	Olimp	without p.s.t.	without treatment (C)	3,44	148,45	558,00	119
			Rhyzogumin	0,5	3,22	136,46	500,01	109
				0,75	2,04	144,89	375,64	92
		Peremojets	without p.s.t.	without treatment	2,26	146,28	358,50	90
			Rhyzogumin	0,5	2,57	146,64	346,92	90
				0,75	2,48	152,28	325,85	83
Lupine narrow-leaved	Lupine narrow-leaved	Peremojets	without p.s.t.	without treatment	2,18	148,23	392,07	88
			Rhyzogumin	0,5	2,35	149,71	374,92	86
				0,75	2,60	151,75	346,21	84
		Lupine narrow-leaved	without p.s.t.	without treatment	2,52	156,75	352,22	83
			Rhyzogumin	0,5	2,60	151,75	346,21	84
				0,75	2,60	151,75	346,21	84

(End of Table 2)

Nº	Culture	Variety	Pre-sowing seed treatment	Retardant concentration, %	Yield, t/ha	Cost, dollars / t	Relatively net profit, dollars / ha	Profitability level, %
4	Chickpeas	Pegas	without p.s.t.	without treatment (C)	2,11	146,74	582,14	111
				0,5	2,45	149,22	667,85	125
			Rhizogumin	0,75	2,85	152,38	646,42	119
		Skarb	without p.s.t.	without treatment	2,25	151,12	632,14	116
				0,5	2,25	191,14	594,14	87
			Rhizogumin	0,75	2,64	166,03	679,52	115
5	Soybean	Holubka	without p.s.t.	without treatment (C)	3,08	149,35	691,02	139
				0,5	2,9	118,21	664,54	123
			Rhizogumin	0,75	3,04	187,60	488,46	113
		Azymut	without p.s.t.	without treatment	3,23	182,46	524,35	119
				0,5	3,42	174,10	610,53	129
			Rhizogumin	0,75	3,31	169,60	582,75	135
Azymut	without p.s.t.	without treatment	3,12	172,14	666,10	132		
		0,5	3,43	160,67	670,07	148		
	Rhizogumin	0,75	3,66	157,39	693,89	154		
			1	3,55	165,32	638,32	142	

Over the years of experimental research, the maximum indicators of grain and fodder productivity in the varieties of the proposed legumes have been determined. The best indicators of economic efficiency, namely the level of profitability – 154% were observed for the technology of growing soybeans of the Azimuth variety, where the bacterial preparation Rhizohumin was used in pre-sowing seed treatment and in combination with retardant treatment (0.75%). The cost and profit were \$ 157.39 / t and \$ 693.89 / ha, respectively.

Slightly lower indicators of economic efficiency, namely the level of profitability – 139% were observed for the technology of growing chickpeas variety Skarb, where used in pre-sowing seed treatment bacterial drug Rhizohumin and in combination with retardant treatment (0.75%). The cost and profit were \$ 149.35 / t and \$ 691.02 / ha, respectively.

The lowest indicators of economic efficiency, namely the level of profitability – 72% were observed for the technology of growing peas of the sowing variety Tsarevych, in the control version without treatments. The cost and profit were \$ 75.22 / t and \$ 185.75 / ha, respectively.

In white lupine Chabanskyi indicators of economic efficiency, namely the level of profitability – 119% was observed for cultivation technology, where the bacterial preparation Rhizohumin was used in pre-sowing seed treatment and in combination with retardant treatment (0.75%). The cost and profit were – 148.45 dollars / ton and 558.00 dollars / ha.

In areas of narrow lupine plant varieties Skarb economic efficiency indicators such as profitability – 84% noted for the cultivation technology, which applied in pre-sowing seed processing Ryzohumin bacterial drug and in combination with processing retardants (0.75%). The cost and profit were – 151.75 dollars / t and 346.21 dollars / ha.

Therefore, the largest increases in grain and fodder productivity were obtained by seed treatment with the bacterial preparation Rhizohumin and spraying of crops with chlormequat chloride retardant in the budding phase.

6. Practical value

Improving the efficiency of alternative fertilizer systems for legumes (peas, soybeans, chickpeas, lupines) and their impact on soil fertility, its physicochemical composition and high yields using fertilizers of

microbiological and biologically stimulating nature allowed for use in safe and organic cultivation technologies.

In modern agriculture, the cultivation of legumes has become widespread, which are characterized by high productivity, liquidity in the market. However, their cultivation is associated with the use of high rates of mineral fertilizers with an acid reaction to the soil, intensive use of soil pesticides and tillage methods that promote development of erosion processes, creation of a subsoil microbiological condition of a sole, deterioration of physical and chemical indicators of soil because of limited receipt in soil organic residues. Crops such as corn, sunflower, rapeseed and sugar beet create tensions in agrocenoses. At the same time, legumes require low rates of phosphorus-potassium fertilizers, and nitrogen enters them due to the symbiotic activity of microorganisms, a significant number of which remains for subsequent crops. The root system of legumes is well developed and able to withstand drought and well drains the soil and restores its structure and has a positive effect on the soil microbiota.

The development of the principles of alternative fertilizers, green manures, taking into account the change in the structure of sown areas in the direction of intense crops on these principles of legumes will improve the dynamics of physical and chemical parameters of the soil and their physical and mechanical structure.

Based on the obtained research results, their economic analysis and in order to grow high grain yields of legumes at the level of 3.66 t/ha by agricultural formation of the right-bank Forest-Steppe of Ukraine, it is recommended:

- sow intensive soybean variety Azimuth;
- carry out pre-sowing treatment of seeds with bacterial preparation Rhizohumin (600 g per hectare of seeds) and treatment with retardant at a concentration of 0.75% in two terms: the first – in the budding phase, the second – in the phase of grain filling (15 ml / ha).

7. Conclusions

Calculations of the economic efficiency of the experimental variants showed that the cost of growing legumes at prices at the end of 2020 ranged from 72 to 154% depending on the studied variants. However, in all variants of the experiment, soybeans provided a high net profit and high profitability. All economic indicators largely depended on the variety of legumes studied,

pre-sowing treatment and retardant concentration. From the economic point of view, it is most expedient to grow soybean of the Azimuth variety with the use of the bacterial preparation Rhizohumin and retardant with a concentration of 0.75% in the pre-sowing treatment of seeds. Although other retardant concentrations had higher economic performance than controls, they were inferior in that the retardant concentration was 0.75%.

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