

CHAPTER 1

ECOLOGY

BIOCHEMICAL COMPOSITION OF WHITE CABBAGE DEPENDING ON THE LEVEL OF SOIL CONTAMINATION WITH CADMIUM AND LEAD BY APPLYING THE MELIORANTS AND DIFFERENT SYSTEMS OF FERTILIZER

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Statement of a problem. Today, in terms of environmental pollution by various pollutants pressing issue arises of providing the population biologically valuable food, important among which is occupied by vegetables. However cultivate environmentally safe vegetable production is extremely challenging because about a fifth of the agricultural land in Ukraine to some extent contaminated by heavy metals (HM). Among them, mercury, cadmium and lead characterized by a considerable stability, high toxicity and pronounced cumulative properties. Toxic effect on plants showing heavy metals in soil and is a moving and potentially mobile forms, which determine the level of danger for plants, and eventually for men.

Analysis of recent research and publications. One of the most common vegetables in Ukraine is white cabbage. But resistance (tolerance) plants from the family Brassicaceae to the toxic effects of heavy metals is insignificant, through genetic features. Thus, excess levels of MPC 3–5 mobile forms of Cd and Pb on acidic, poor in humus content and clay, light granulometric composition soils can reduce the yield and quality of white cabbage.

Relevance today acquires development, research and practical introduction in specific agro-climatic conditions of effective and accessible, environmentally safe of fertilizer system, thanks to which passes is high-speed detoxification of cultivated soil that is contaminated of HM with the restoration of its of fertility, increasing protection (buffer) properties that generally contributes to obtaining ecologically safe and of biologically valuable crop production. Application meliorates as antidotes, prevents migration of contaminants into adjacent environment, processes reduce the toxicity caused by pollution.

Formulation of the problem. The purpose of research – to study the effect of organic, mineral and organic-mineral fertilizing systems in combination with liming on mobility of Cd²⁺ and Pb²⁺ in soil and translocation processes in plants white cabbage depending on different gradations pollution, and the impact of heavy metals on biochemical structure of white cabbage.

The main material. During three years of research in the field of fruit and vegetable growing department, technology, storage and processing of plant products Lviv National

Agrarian University studies were conducted at ameliorants' on the effects of different fertilizer system and the behavior of cadmium and lead in the "soil-plant". Sowing white cabbage (sort Yaroslavna), taken by the test plant was carried out in the third week of May in simulated pre-contaminated soil with heavy metals. Salt CdCl_2 and $\text{Pb}(\text{CH}_3\text{COO})_2$, were used as the pollutants that were introduced as an aqueous solution in simulated contamination levels 1; 3; 5 MPC in the gross forms separately in autumn in soil in 0 - 20 cm depth and in a week later there was applied the ameliorants CaCO_3 at the norm 5 t/ha (by hydrolytic soil acidity) according to the scheme of experiment. The mineral fertilizer nitroamofos of brand 16:16:16 and the organic fertilizer Biohumus according to the scheme of experiment were applied in early spring.

The following factors were studied in the laboratory-field model experiments:

Factor A – the levels of soil contamination by heavy metals (Cd and Pb);

Factor B – the fertilizer system and meliorants.

Scheme experiment according growing white cabbage included such options: 1) The control variant (without fertilizer); 2) $\text{N}_{136}\text{P}_{136}\text{K}_{136}$; 3) Biohumus 8 t/ha; 4) $\text{N}_{68}\text{P}_{68}\text{K}_{68}$ + Biohumus 4 t/ha; 5) $\text{N}_{136}\text{P}_{136}\text{K}_{136}$ + CaCO_3 5 t/ha; 6) Biohumus 8 t/ha + CaCO_3 5 t/ha; 7) $\text{N}_{68}\text{P}_{68}\text{K}_{68}$ + Biohumus 4 t/ha + CaCO_3 5 t/ha.

We determined the concentration of mobile and total forms of Cd and Pb concentrations in soil and in plants white cabbage by atomic absorption spectrophotometry on the device C115M by certified and standardized methods with subsequent statistical data processing [4].

The research has established that soil and climatic conditions, the fertilizer system, meliorants and the levels of soil contamination by heavy metals had a great influence on the mobility of cadmium and lead in the soil by cultivating the white cabbage. It must be noted, that by increasing the level of soil contamination by cadmium and lead from 1 to 5 MPC there was observed the only tendency to the increase of concentration of heavy metals mobile forms in the soil of all variants, but the general laws of mobility of heavy metals in the soil among the variants were stored. However, great influence on the mobility of lead and cadmium in the soil had great influence of fertilizers and ameliorants

It was established, that for all variants of experiment, where were used the mineral fertilizers and ameliorants the concentration of mobile forms of cadmium in soil was lower, comparing with a control variant, where were not applied the agrochemicals. But the efficiency of fertilizers concerning the reducing of mobile forms Cd^{2+} in soil in various variants was manifested differently.

The research has shown, that for reduce the concentration of mobile forms of lead in the soil had a greater impact in applying only one organic fertilizer in the full norm Biohumus 8 t/ha. We note, that the most effectively fixed mobile fractions of cadmium and lead in the soil behind joint application of organic and mineral fertilizers at half the norms $\text{N}_{68}\text{P}_{68}\text{K}_{68}$ + Biohumus 4 t/ha, it is especially effective manifested with liming of the soil at norm $\text{N}_{68}\text{P}_{68}\text{K}_{68}$ + Biohumus 4 t/ha + CaCO_3 5 t/ha, with such norms concentration of mobile forms of Cd^{2+} and Pb^{2+} in soil was the lowest.

Research has established that on the biochemical composition of white cabbage had an impact a variety of factors, namely: soil and climatic conditions, the growing season of plants, fertilizer system, meliorants and the level of soil contamination with

heavy metals.

The researches demonstrated the general trend, namely by increasing the levels of contamination of soil, as Cd and Pb from 1 to 5 MPC on all variants, the indexes of the quality of white cabbage (dry matter content, total sugars, ascorbic acid) has been decreased, but the content of nitrate has been increased. Fertilizers and ameliorants in different amount and proportions have shown a significant effect on the biochemical composition of white cabbage.

Research has established that best quality of white cabbage with minimal concentrations of cadmium and lead, was received at application of comprehensive system of fertilizers at norm $N_{68}P_{68}K_{68} + \text{Biohumus } 4 \text{ t/ha} + \text{CaCO}_3 \text{ } 5 \text{ t/ha}$. In this variant we have noted a lowest concentration of heavy metals in white cabbage, even at levels of soil contamination cadmium and lead by in 5 MPC.

The research has established a significant impact of fertilizers and meliorants on the reducing of accumulation of heavy metals and nitrates in white cabbage and the formation of quality indicators of crop. Consequently, the use of organic and mineral fertilizers combined with liming affected the high quality of the white cabbage with permissible concentrations of heavy metals.

Conclusions. Established, that the application of organic and mineral fertilizers in combination with liming of soil at norm $N_{68}P_{68}K_{68} + \text{Biohumus } 4 \text{ t/ha} + 5 \text{ t/ha CaCO}_3$ on the contaminated dark gray soil with cadmium and lead has helped to reduce the concentration of mobile forms of Cd^{2+} and Pb^{2+} soil, thus significantly reduced their accumulation in plants of white cabbage, which is reflected in high quality of production that met the hygiene requirements and is safe for consumption.

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FITOCENOTICAL CHARACTERISTICS OF THE CONDITION OF *OXYCOCCUS PALUSTRIS* PERS. POPULATION ON THE AREA OF YAVORIV REGION

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Setting the problem. Wet lands vegetation on the area of Yavoriv region occupies quite a big territory. These are unique wet lands with rare plant species. However, the ecotypes themselves and their quantity have undergone digressive changes due to the fall of the level of groundwater. The swamps are becoming overgrown with forest vegetation and are turning into shrub swamps [5].

Taking into consideration the rarity of the swamps vegetation of *Oxycocco-Sphognetea* kind on the area of Yavoriv region there is a reasonable necessity of regular botanical supervision of wet lands vegetation.

The analysis of recent researches and publications. The vegetation of Yavoriv region having been investigated for 200 years by such prominent botanists as Z. Krul' (1878), E. Voloschak (1874), S. Stoyko (1990), M. Soroka (1999, 2008), M. Zahulskyi (2000) [3; 5] and many other researchers. However, the recent condition of *Oxycoccus palustris* Pers. population in this region is not clear.

Setting objectives. For the purpose of the investigation of specificity and condition of coenopopulations *Oxycoccus palustris* Pers. in different biotypes of Yavoriv region

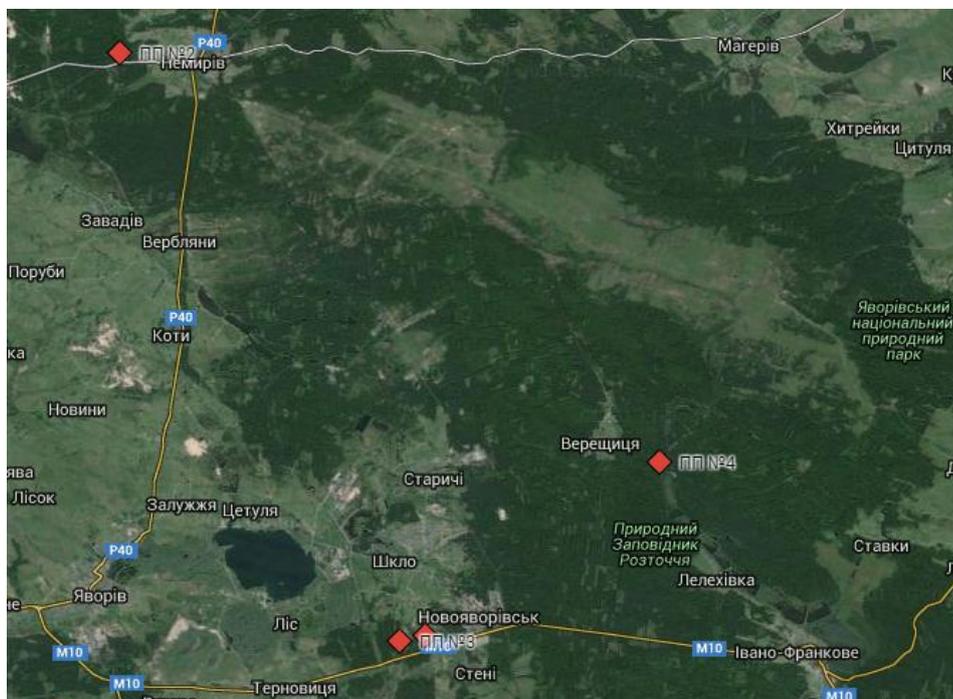
(precisely in western, central and southern parts of Yavoriv region) four plots were detected and founded.

Presentation of the basic material. The swamps that were investigated in Yavoriv region are a mixed type of poor fen. They are characterized by rather small variety of plant species.

Cranberry marsh or ordinary cranberry (*Vaccinium oxycoccos*, *Oxycoccus palustris* Pers.) is a hamifit kind *Vaccinium* of heather group (*Ericaceae*). Ecological and biological characteristics of this kind were elucidated in the works by O.Orlov [4]. These plant species grow primarily in sphagnum bogs in wet forests (A4-A5) and pine forests (B4-B5). In the Ice Age flood areas of rivers of Yavoriv region, which preserved swamps, served refuge for many species of boreal flora [5]. Cranberry marsh – a relic of the Ice Age, is a part of the vegetation of this area.

The researches were aimed at investigating the species composition of groups, covering area of plot O. *palustris*, abundance and wet lands digression caused by human pressure. Description of plant communities was carried out in accordance with generally accepted geobotanical methods. The research was conducted at the beginning of July 2015. The projective cover of cranberry was determined according to Ramenskyi, the abundance according to Drude. List of species was compiled using 'List of Higher Plants of Ukraine'(1987). The indication of the marsh vegetation degression was carried out according to the guidelines of Boch, Mazyng (1979) [1].

The plot 1 (picture1) was located in Novoyavoriv'sk forestry, a part of Rava Rus'ka forestry, in Yavoriv region and it occupies 50 m². The plot 2 was located not far from the health resort Nemyriv, in the eastern part of the lake. The area of the swamp is 10m². The plot 3 is situated near the village Stadnyky of Yavoriv region (Novoyavoriv'sk forestry, Rava Rus'ka forestry). The area of the swamp is not big – 10m², although with obvious anthropogenic pressing. The plot 4 is located not far from village Vereschytsya in Yaniv nature park, that is the part of Yavoriv nature park. According to physical and geographical characteristics the plots 1, 2, 3 are situated in the area of Peredkarpattya (Nadsyannya), although plot 4 is located in the zone of Podil'sk Upland (Roztochya). It should be mentioned that plots 2 and 4 are located on the territory of nature reserve fund.



Picture 1. The location of plots *Oxycoccus palustris* Pers. in Yavoriv region

Through phytocoenotic characteristics of the wetland communities, it was noted that due to specific factors in the environment of sphagnum communities there is a small number of species (table. 1). The environment of these plant communities is characterized by high humidity, acidity but low aeration and mostly poor mineral nutrition.

Table 1

Phytocoenotic characteristics of *Oxycoccus palustris* Pers

№	The species composition of plants	Projective cover, %	Abundance, according Drude	Digression stage
Plot 1				
1	<i>Oxycoccus palustris</i> Pers.	50	Cop ³	Second stage
2	<i>Sphagnum magellanicum</i> Brid.	50	Cop ³	
3	<i>Menyanthes trifoliata</i> L.	10	Cop ¹	
4	<i>Carex panicea</i> L.	10	Cop ¹	
5	<i>Carex flava</i> L.	+	Sp	
6	<i>Poa palustris</i> L.	+	Sp	
7	<i>Viola palustris</i> L.	+	Sp	
8	<i>Polytrichum juniperinum</i> Brid.	+	Sp	
9	<i>Athyrium filix-femina</i>	+	Sol	

	(L.) Roth ex Mert.			
Plot 2				
1	<i>Oxycoccus palustris</i> Pers.	10	Cop ¹	First stage
2	<i>Polytrichum juniperinum</i> Brid.	50	Cop ³	
3	<i>Sphagnum magellanicum</i> Brid.	50	Cop ³	
4	<i>Vaccinium myrtillus</i> L.	15	Cop ²	
5	<i>Ledum palustre</i> L.	15	Cop ²	
6	<i>Vaccinium vitis-idaea</i> L.	+	Sol	
7	<i>Athyrium filix-femina</i>	+	Sol	
Plot 3				
1	<i>Oxycoccus palustris</i> Pers.	10	Cop ¹	Second stage
2	<i>Sphagnum magellanicum</i> Brid.	40	Cop ³	
3	<i>Polytrichum juniperinum</i> Brid.	20	Cop ²	
4	<i>Carex panicea</i> L.	10	Cop ¹	
5	<i>Menyanthes trifoliata</i> L.	+	Sp	
6	<i>Eleocharis palustris</i> R. Br.	+	Sp	
7	<i>Athyrium filix-femina</i>	+	Sol	
Plot 4				
1	<i>Oxycoccus palustris</i> Pers.	50	Cop ³	Stable
2	<i>Sphagnum magellanicum</i> Brid.	50	Cop ³	
3	<i>Vaccinium myrtillus</i> L.	15	Cop ²	
4	<i>Vaccinium vitis-idaea</i> L.	15	Cop ²	
5	<i>Carex panicea</i> L.	10	Cop ¹	
6	<i>Vaccinium uliginosum</i>	5	Cop ¹	
7	<i>Callna vulgris</i> L.	5	Cop ¹	
8	<i>Eriophorum vaginatum</i> L.	5	Cop ¹	
9	<i>Carex flava</i> L.	+	Sp	
10	<i>Poa palustris</i> L.	+	Sp	
11	<i>Athyrium filix-femina</i>	+	Sol	
12	<i>Polytrichum juniperinum</i> Brid.	+	Sol	

Cranberry bushes are the most abundant on plots 1 and 4. Cranberry-sphagnum groups on plot 1 are surrounded mostly by pine trees. Sporadically around marsh communities grow oaks, birches, alders, willows, buckthorns, blackberry bushes.

Plot 4 is located in Yavoriv national park and is characterized by bigger number of undershrub plants compared to other areas that were investigated. Ecotypes represents mesotrophic sphagnum bog with sparse stands of birch and pine. Among the shrubs buckthorn is dominating, less common is hazel. What undershrubs are concerned, except cranberries, there is a large number of blueberries and heather. It should be mentioned that cranberries in this bog grow not only among sphagnum, but also among polytrichum. That means that cranberries here form groups with sphagnum and polytrichum. Signs of human impact on this swamp are almost absent.

Both plots are rather inviolated. Wood circle around ecotypes is well developed. In the grass cover the dominating are typical plants for transitional marshes: a lot of *Sphagnum magellanicum* Brid. and *Oxycoccus palustris* Pers. Trampled paths are not observed.

Marsh ecotypes of plot 3 are with obvious anthropogenic pressure. Around the groups of *Sphagnum magellanicum* Brid., *Polytrichum juniperinum* Brid. there are paths that are more than 25 cm wide. Although concrescence of the leafage of *Pinus sylvestris* L. makes only 20 %, the intense rooting of representatives of forest communities *Athyrium filix-femina*, *Vaccinium myrtillus* L., *Carex panicea* L. takes place. This fact is connected with the decrease in soil moisture in trampled areas. In vegetation cover we can observe the increase of the plant species *Vaccinio-Piceestea*. *O. palustris* abundance is much less per unit area compared to other areas that were examined. Intensive visiting of this swamp is connected with the collecting of blueberries in the adjacent area.

Somewhat better situation is on plot 2, near the recreational resort Nemyriv. Although marsh cranberry is not abundant here (maximum 10 pers. per 1m²), human impact here is insignificant. This can be explained with the fact that the territory is difficult to reach, due to overgrown swamp trees and shrubs. Tree and shrub layer is formed mainly by *Abies alba* Mill., *Alnus glutinosa* (L.) Gaerth., *Betula pendula* Roth., *Pinus sylvestris* L., *Picea abies*, which sometimes form a curtain.

This section of the bog refers to the nature park Nemyriv (276 hectares), which was established to preserve the white fir.

Conclusion. Identified habitat *Oxycoccus palustris* Pers in Yavoriv region are not highly productive, but are mostly in a satisfactory environmental and phytocoenotic condition. It was noticed a significant human impact on cranberry shrubs that are located on the territory of Novoyavoriv'sk forestry. On the contrary, what concerns cranberry shrubs that are located on the territory of the nature park, human impact is insignificant. Plot 1 is experiencing the greatest human impact.

Taking into consideration the rarity of wetland communities of *Oxycocco-Sphagnetea* class on the territory of Yavoriv region, it is necessary to carry out regular botanical monitoring of populations *Oxycoccus palustris*.

The monitoring of *Oxycoccus palustris* Pers. on the territory of Yavoriv region shows that ecotypes populations are currently exposed to biotic and abiotic forms of influence. There are both positive and negative trends in development of localities of marsh cranberries. It should be noted the gradual normalization of the hydrological regime on this territory. Thus, the increase of *O. palustris* on certain plots is evident.

Coenopopulations *Oxycoccus palustris* Pers. in Yavoriv region need protection. Environmental and educational work with local people is also required.

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PECULIARITIES OF MIGRATION AND ACCUMULATION OF ORGANOCHLORINE POLLUTION IN SOIL

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The formulation of the problem. In recent decades, in Ukraine and in the world, due to the intensification of agricultural production, questions about pesticide contamination of agroecosystems, which have a negative impact on the multilateral biosphere, the scale of which is compared with global environmental problems, are more actual. The accumulation of a significant amount of pesticides that are dangerous to public health and threaten the environment is because the storage conditions do not meet current standards. Toxicants of different origin gradually changing physical and chemical properties of soils, violating the condition of the soil, reduce the number of soil microbiota and reduce its fertility; as a consequence, the value of crop production and animal husbandry is reducing too.

An important problem is the pollution of environmental objects persistent organic pollutants, including organochlorine pesticides (OHP), such as DDT and its metabolites (DDE, DDD), which are able to significant bioconcentration in the link of food webs. Despite the ban on production and use, through exceptional stability in the environment, migration of significant amounts of organochlorine pesticides happens to this day.

The aim of this work was to make the study of migration and accumulation of residual amounts of persistent organochlorine pesticides in the environment.

Presenting main material. The research was conducted in dark gray-ashed soils in the territory of a sanitary zone of out-of-use storage of agrochemicals in the village Glinsko, Zhovkva district in Western steppes of Ukraine.

Analysis of soil samples was conducted in Lviv regional state and design and technology center of protection of soil fertility and quality of product "Oblderzhrodyuchist".

Given the ability of organochlorine pesticides migrate in the profile soil, was investigated soil samples, selected to a depth of 1 m layer every 20 cm in areas with the highest levels of contamination (at a distance of 10 westbound and eastbound from the storage of chemicals in the village Glinsko). The regularity of migration DDT in the genetic horizons dark gray-ashed soils have been established.

So, basically root layer of soil (0–40 cm) pollution levels of residues of organochlorine pesticides were within 10–24 TLV, and in the soil layer 0–20 cm the number of the total content of DDT were slightly higher than in the 20–40 cm layer. This can be explained better humus of topsoil, availability of sod that is a certain natural battery of substances of different nature, including pollutants.

The maximum amount of DDT found at a depth of 60 - 80 cm (18 TLV eastbound and 35 TLV westbound). This depth corresponds horizon soil with illuvium, which is characterized by clear signs of accumulation learned from upper horizons substances, most of the colloids, which are delaying toxicants.

Even at a depth of 1 meter, the number found DDT exceeded setting hygienic standards in 9.9 and 18 times (eastbound and westbound respectively), with the close occurrence of groundwater poses a risk of pollution.

Conclusions. DDT and its metabolites were found in the upper arable layer (0 – 20 cm) in concentrations higher than the TLV to 24.3 times, which may explain the ability of soil to accumulate the most pesticides.

Significant accumulation of DDT residues in soil layer of 60–80 cm at a distance of 10 m from the west at 35.2 TLV (horizon soil with illuvium) is characteristic. This process is due to genetic features dark gray-ashed soils in which the upper part of the humus horizon (25–35 cm) is eluvium well, and the lower (30–60 cm) is illuvium, horizon soil with illuvium is lying deeper. In horizon soil with illuvium increases the density structure and reduced soil porosity. This feature dark gray-ashed soil forms a natural barrier to the migration of chemical substances, including xenobiotics.

Thus, the migration of metabolites organochlorine pesticides soil profile depends on the genetic characteristics of the soil, and their localization can be a source of additional income toxicants in the bodies of plants with the strong root system.

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ECOLOGICAL APPROACHES TO THE UTILIZATION OF CEREAL STRAW

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Bibl. 7. P. 22–26.*

Problem formulation. The main objective of our research was to assess the opportunities and prospects of ecological cereal straw utilization in different economic sectors of Ukraine.

Introduction of main material. In terms of CO₂ accumulation in the atmosphere agricultural production accounts for up to 25 % of greenhouse gas emissions owing to humus consumption. Therefore, a solution to the problem of humus accumulation in soil may contribute to the resolution of the global warming problem. In accordance with ecological approaches a solution to the principal task of soil cultivation is to reduce thickness in relation to the depth and going through the field with tillage machinery.

It worth mentioning that within the environmental and ecological policy of European Union, according to Directive 2009/28/EC of the European Parliament concerning the contributions towards the utilization of renewable energy sources, towards the reduction in greenhouse gas emissions when using biofuels should constitute no less than 35 %. The technology of energy production from biomass may be considered as economically viable if its application results in the reduction of greenhouse gas emissions in comparison with the traditional fuel usage.

Biomass is considered to be carbon-neutral in terms of carbon dioxide emission since the same amount of CO₂ is emitted as it was absorbed by a plant at its growth stage during the process of incineration.

The utilization of straw as an energy source for direct burning has some peculiarities that should be taken into consideration (high content of alkali metals and silicon compounds, high content of chlorine in oat, barley and rape straw, the moisture content of straw as well as the degree of withering).

In terms of environmental friendliness and energy efficiency straw-bale construction techniques are showing considerable promise. They require at least two times less fuel for heating season in connection with the fact that straw is a better heat insulator than wood or stone. Straw may be used in construction as straw bales made from pressed rye, flax or wheat straw, that are tied with metal wire (nylon cord), or are in compressed (pressed) form.

Straw, as a building material, is allowed to be used in EU countries. According to ISO standards straw bale examples are checked for incombustibility (EN ISO 1182 on the basis of ISO 1182) and for combustibility (EN ISO 11925-2.22). Straw that is used in construction generally satisfies the requirements of class E (normal combustibility). Resistance to biological influence on straw bales (due to ON 6010 / DIN EN ISO 846 EOTA CUAP) corresponds to the level of 25 %–50 % (classes 2–3).

The technique of multilayer wall construction, made of straw bales and strengthened with the help of gunite, is quite promising for application.

Conclusions. The utilization of straw as an organic fertilizer and as an important factor of soil formation process in agrocoenosis of crop rotation is considered to be relevant at this time and is a strategic orientation of agricultural sector development in Ukraine. Cereal straw is the main source of waste fuel from agricultural plants, though, it is used absolutely ineffectively as a strategic resource of Ukraine. Ecological effectiveness of bioenergy technologies is possible if the installations on solid biomass are in compliance with the current and future requirements of Directive 2009/28/EC. Only those technologies that make use of ecological wall constructions that are made of straw bales are promising in the building sector. The effectiveness of such constructions is based on the fact that they function as wall frame by protecting straw from external, mechanical and other factors.

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ENVIRONMENTAL ASPECTS OF DRINKING WATER IN THE SKOLE DISTRICT OF LVIV REGION

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Bibl. 7. P. 27–31.

Statement of the problem. The quality of tap water in the city of Skole and rural settlements causes a lot of complaints from the water consumers. These complaints in most cases are fair, especially since MKP "Salvatational" does not publish the quality indicators of the water that takes the users. The poor quality of tap water has led many people to seek an alternative. A significant portion of residents Skole for drinking water uses imported water, which several companies offer and deliver it in tanks to different parts of M. Skole, others buy bottled water.

The solution to the problem of water quality, Skole district, is the repair or reconstruction of existing (Skole town, village Slavske) and the construction of new (Verkhneye sinevidnoye) treatment facilities. You also need to channel M. Skole, SMT. Slavsk, S., Kozova, Verkhneye sinevidnoye. Therefore, the study of the quality of surface water resources is an urgent problem of the mountainous part of Lviv region.

Analysis of recent researches and publications. The water quality of the river Opir, which channel surrounds the regional center of its Eastern outskirts, gravely deteriorating, despite the operation of the station treatment of municipal waters. The river brings the Resistance into the river Stryi unnaturally contaminated water with dangerously high content of chemicals and poor index of biotic consumption and chemical bonding of oxygen [5; 7]. Well water in the villages of Skole district, on the majority of indicators are of satisfactory quality, except for the nitrogen content of nitrite, which is usually higher than the Mac [6]. This means that safe drinking water well water is not good. Therefore, in the villages need construction of water pipes to ensure safety from adverse effects of floods, flooding and other disasters that contaminate wells.

The purpose of the research is the determination of the ecological quality of surface waters, Skole district, Lviv region in terms of their chemical composition.

Materials and methods. Selection and environmental assessment of water quality of the river Opir and well water in the villages of Skole district of Lviv region was performed on the basis of the current classification system and standards for assessing the quality of surface waters of Ukraine, presented in the "Methodology of assessing the quality of surface waters by corresponding categories" in 2007 [1–3]. The priority items that require research are: the point of discharge rain water and waste water of towns and villages, livestock farms, wastewater individual enterprises; the final alignments of large and medium rivers and the like.

Presentation of the basic material. Stryi and Opir is a typical mountain river with steep banks, very sinuous channel and a significant velocity. During the period of snowmelt and spring and summer heavy rains, these rivers are flowing, the water level rapidly increased, repetitive flooding. The location and activity of the city of Skole on the left terrace of the river Resistance significantly affects the physico-chemical parameters of river water throughout the entire observation period. So, its alkalinity, total hardness and dry residue more or less through the city. The contents of sulfates (except first quarter) and chloride above the confluence of the river Opir in Stryi. At the same time, the indicators and the content of calcium not exceeding the norms for river water. On the other hand, magnesium in the third quarter and total iron during the entire observation period were kept in quantities exceeding MAC.

Indicators Okinawans river water, indicating the presence of contaminating reducing agents of organic and inorganic nature, one to five times for BOD-5 (except first quarter) and one to three times the chemical okint exceed the standard in both observation points. The negative impact of Skole, the quality of river water Resistance on these indicators is noticeable, but not critical to the Study of the seasonal dynamics of physico-chemical parameters and concentrations of chemical components showed that the seasonal distribution depends on the impact as natural factors and economic activities. In The skol operates the City municipal enterprise "Vodokanal Skole", which supplies water to customers and collects and purifies municipal wastewater of the city. Sewage treatment plants located in the vicinity of the village of Dubina and accept the entire volume of urban waste. The discharge of treated or untreated sewage occurs in the Resistance, so it is important to know how effective the purification system and how a significant change in the water quality in the river under the impact of discharged effluents.

In comparison with indicators above the stream for a wastewater treatment plant for the river water below sewage treatment plants has a large chroma, neutralino reaction, large stiffness and the amount of dry residue. The condition of the water. Resistance at the compliance point that is located downstream of the treatment facilities after the city of Skole, changes in the direction of growth in terms of the content of sulfates and chlorides. The highest concentration of sulfates and chlorides found in the first quarter, when the river is shallow, and discharges does not decrease. This means that during this period, slightly reduced natural dilution of discharges to natural water Resistance. Biotic oxygen consumption in water, selected after treatment facilities in the first quarter, amounted to $45.4 \text{ mg O}_2/\text{dm}^3$, which is 20 times higher than the norm for the river waters. In the same quarter at the same point for monitoring the chemical oxidation of water Bearing 3.8 times higher than the normal level. Therefore, the degree of purification of municipal waters, which are discharged with M. Skole, insufficient regulatory and discharges treated and untreated effluents still affect the quality of the water, the Resistance in the event of their getting into the mainstream.

Conclusions. Surface water Screw dini have a significant contamination with sewage of the town of Skole. The water quality of the river Opir, which bypasses the city, gravely deteriorating despite the work station treatment of municipal waters. The river brings the Resistance into the river Stryi unnaturally contaminated water with dangerously high content of sulphides, chlorides, nitrogen compounds, especially nitrates

and nitrites, as well as the poor index of biotic oxygen consumption and chemical oxidation.

Well water in the villages of Skole district are of satisfactory quality, except for the indicator of nitrogen content of nitrite, which is usually higher than the Mac. This means that safe drinking water well water unusable. Therefore, in the villages need construction of water pipes to ensure safety from adverse effects of floods, flooding and other disasters that contaminate wells.

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CHAPTER 2 CROP GROWING

GROWING OF BUCKWHEAT IN SHORT ROTATION ON SOD-PODZOLIC SOILS IN THE CONDITIONS OF THE CARPATHIANS

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Bibl. 5. P. 32–36.*

Formulation of the problem. Among cereals buckwheat in Ukraine is the most common culture. This is due to high food and medical and dietary properties of grains. However, the level of production of buckwheat does not meet the needs of the state. One way to increase the harvest of this culture is the introduction of highly competitive production technologies of cultivation which would ensure maximum realization of the potential of modern varieties of buckwheat.

The area under buckwheat in Ukraine reduced because this culture is characterized by specific features of biology power growth and gained status capricious in growing crops. In Ukraine, buckwheat sown area of more than 350 - 400 thousand.he. Grow it in Poland, France, the Netherlands and other European countries, the US, Canada and Australia. Large areas of buckwheat in China. Small areas it occupies in Japan and India.

In Ukraine, the most favorable for growing buckwheat is forest steppe zone and Polissya. Buckwheat prolonged intense growth observed since the beginning of germination to maturation. This feature combined with high total capacity at relatively low and unstable seed productivity. Intensive growth and rapid transition from vegetative to generative period of ontogenesis caused quite high activity meristem tissue formation and long period of flowers. Although buckwheat is of great economic importance, it yields remain volatile and vary by year.

Presenting main material. Potential performance buckwheat is high enough. Intensive cultivation technology it provides: sowing buckwheat after placing the best predecessors, tillage and fertilization on soil properties into account, the predecessor of buckwheat and demands the availability of nutrients to the phases of growth, weeding, fertilizing plants, the use of chemical growth regulators, pollination by bees .

The results showed that the highest yield of buckwheat seeds in shortly – rotation – 2.18 t/ha in 2015 that four rotation of the fields with saturation 75 %, 25 % oil (winter rape, winter wheat, buckwheat, barley). Note that it is on this rotation received the greatest profit of UAH 14068.0 hectare if the profitability – 212.7 %.

It was established that the lowest yield of buckwheat – 1.91 t/ha in 2015 was a three-field crop rotation with grain saturation of 33 to 100 %, oil – by 33 %, legumes – 33 % (winter wheat, spring barley, buckwheat). Economic indicators thus comprised: net income – UAH 11655.0. the level of profitability of 345.8 %. As a result of the studies

determined that the lowest cost of cultivation of buckwheat in the three-field crop rotation 176.4 UAH/Kg, and the highest in four rotation of the fields – 212.7 UAH/kg, respectively.

Conclusions. In new economic conditions, which have a narrow specialization of production, appropriate crop rotation to develop and implement a short (4–5 fields) rotation. The highest yield of buckwheat (2.14 t/ha) was obtained when grown in rotation with four rotation of the fields leguminous saturation of 75%.

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ECONOMIC EFFICIENCY OF SUGAR BEETS GROWING DEPENDING ON TILLAGE METHODS

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Bibl. 6. P. 37–40.

Setting of the problem. The rapid growth in energy resources prices leads to the search of ways to reduce expenditures of growing agricultural crops. In particular, it concerns sugar beets since this culture is one of the most energy-consuming and labor-intensive.

The main methods of increasing the economic efficiency of sugar beet production are the growth of its productivity and the reduction of expenditures. The reduction of the expenditures on production of sugar beet can be achieved through the minimization of tillage, which includes: the decreasing of the basic tillage depth, the introduction of shallow and surface tillage, replacement of moldboard tillage by moldboard less one.

Main material. Economic efficiency of agricultural production is receiving the maximum quantity of production per unit area at the lowest labor costs and costs per unit of production.

Indicators of the cost of sugar beets gross production depend on the size of the yielding capacity. In the version with the deep plowing on 28–30 cm it was received 31108 UAH/ha concerning the yielding capacity of root crops 61.8 t/ha. In the version of shallow tillage on 14–16 cm the gross production value was higher, so it was

31517 UAH/ha, as the yielding capacity was higher by 1.3 t/ha and amounted for 63.1 t/ha.

Expenditures indicators were calculated according to the technological map of growing sugar beets. Expenditures in the version with the deep plowing for 70 UAH exceeded the amount of expenses for the version with shallow no-plow tillage and totaled of 12 968 UAH/ha.

The sum of profit from sold products is the main indicator of the economic efficiency of sugar beets production. The difference between the versions of profit amounted for 478 UAH/ha in favor of shallow tillage on 14–16 cm.

Lower cost of 204.6 UAH/t of root crops was obtained by a slight reduction of material and financial costs of growing sugar beets and increasing of the yielding capacity in the version of shallow tillage to a depth of 14–16 cm in comparison to the version of deep plowing.

Profitability calculations indicate that the cultivation of sugar beet under the conditions of our area is profitable. The level of profitability on deep plowing amounted for 140 % and on shallow no-plow tillage on 14 - 16 cm – 144 %.

Conclusions. So, shallow no-plow tillage on 14–16 cm is one of the possible methods of increasing the economic efficiency of sugar beets, as it provided the increased profit for 478 UAH and the profitability level amounted for 144 %.

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CHAPTER 3 CROP PRODUCTION

THE YIELD OF SUGAR-BEET DEPENDING UPON THE SCHEME OF HERBICIDES APPLICATION IN THE CONDITIONS OF THE WESTERN FOREST STEPPE ZONE OF UKRAINE

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Problem. In the technology of sugar-beet growing is one of the main problem – weeds control. The plants of this crop because of its morphological features is less competitive as to the weeds and not able to resist them. Even with little weedery the sugar beet yield is reduced sharply.

In modern intensive technologies to obtain high yields of tubers is impossible without the application of herbicides. There are two systems of herbicides application: combined, including pre- and post shoot emergence application and herbicides application during the growing season of weeds. The combined system is recommended strongly for weedery fields.

It should be noted that in contrast to other field crops, in technology of sugar beet growing doesn't exist herbicide that could independently control weeds during the growing season. Moreover, it is not possible to achieve the purity of fields even by single application of tank mixtures of different drugs. Increasing of the application rate is not the way out, as most herbicides, except drugs of Piramin turbo and Holtiks have a negative effect, leading to severe stress effect on sugar beet plants. Therefore, for effective control of weeds throughout the growing season, need a system of consistent three-four times application of herbicides, tank mixture which is determined for each application by weedery type.

Analysis of recent researches and publications. During the first 90 days after the shoots emergence in the sowings of row crops the complex of weeds can absorb from the soil the most accessible forms of nitrogen – 160–200 kg/ha, of phosphorus – 65–90 kg/ha, of potassium – 170–250 kg/ha [2].

To a large extent the problem of weedery can be solved by the application of soil herbicides. It is advisable to apply soil drugs for early sowings, for lower up to (3 %) of humus contents, and on light soils for sufficient moisture [6]. Application of soil herbicides during 3–4 weeks reduces the stress in carrying out of protective measures as

to the control weeds on shoots. It is important to apply soil drugs at risk of delayed application of post shoots emergence due to lack of technology, prolonged rainfall, strong winds and so on. In the zone of sufficient moisture it is more advisable to apply herbicides Piramin turbo, and Piramin Star and Holtiks in soil. [7; 9; 10].

Validity of soil drugs is limited and counts 30–50 days. Therefore, the protective effect of soil herbicides requires strengthening and for sowings protection during the growing season the post shoots drugs are applied. In the recent years, post shoots application has advantage. If necessary, make a mixture of 2-4's active ingredients, and also to apply herbicides by retail to control weeds.

It is very important in time, in the phase of cotyledon weeds to conduct the first post shoots spraying. [1; 3; 6]. For the first application the most selective and soft herbicides are applied with low rates: Holtiks, Piramin turbo, Piramin Star, Betanal expert and others. [5; 7]. As weed shoots on sowings of sugar beets are appeared gradually (within 30–60 days and more) for the full control weeds it is recommended to conduct several consistent applications [11].

For the second time the sowings are sprayed after 6–10 days after the first, when the weeds appeared again or according to recommendations as to the application of certain herbicides. It is necessary to apply herbicides for the third time with the considerable appearance of weeds within 10–14 days after the second spraying [4; 6].

It should be noted that the priority application, the rates and terms of the herbicide application depend on weeds species, phase of their development, weather conditions and the state of plants.

Unsolved problems. Sugar beet plants in the early stages due to the slow initial growth can not resist weeds, shoots which appear in large quantities and rapidly increase their vegetative mass. Weedery of sugar beet sowings can occur during the entire growing season. Therefore, effective control weeds is one of the most important tasks.

It should be noted that in contrast to other field crops, in the technology of sugar beet growing doesn't exist herbicide that could independently control weeds during the growing season. Moreover, it is not possible to achieve the purity of fields by single application or even tank mixtures of different drugs. The increasing of application rates is not the way out, as the most herbicides, except drugs of Piramin turbo and Holtiks have a negative effect, leading to severe stress effects on sugar beets. Therefore, for effective control of weeds throughout the growing season, need a system of three-four times application of herbicides but tank mixture is determined for each application of weedery species.

Problem. The effectiveness of different variants of herbicides application was studied by the scheme presented in Table 1. We studied the most wide-spread herbicides which are often applied in the protection systems of sugar beet from weeds: Betanal Expert (fenmedifam, 91 g/l + desmedifam, 71 g/l + etofumezat, 112 g/l); Betanal Max Pro (fenmedifam, 60 g/l + desmedifam, 47 g/l + etofumezat, 75 g/l + lenatsyl, 27 g/l); Holtiks (metamitron, 700 g/l); Piramin turbo (hlorydazon, 520 g/l); Piramin Star (hlorydazon, 418 g/l + kvinmerak, 42 g/l); Torero (metamitron, 350 g/l + etofumezat, 150 g/l); Grand Lontrel (klopivalid, 750 g/kg); Fyuzilad Forte (fluazyfol-P-butyl, 150 g/l); Kontaktvin (fenmedifam 97 g/l + etofumezat, 94 g/l); Forte Belveder (fenmedifam,

100 g/l + desmedyfam, 100 g/l + etofumezat, 200 g/l); Frontyer Optima (dymetenamid-P, 720 g/l).

On the first variant the postshoots system was applied with three times application of betanalnoi group. The postshoots system was on the second variant, on which Metamitron in the composition of Holtiks and Torero was used three times. On the third variant the combined system was studied, where the first was the application of soil but the next were postshoots. Basic herbicides there were Piramin turbo and Holtiks. On the fourth variant herbicides were applied by postshoots way, the basic herbicide Holtiks was applied. On the fifth variant as basic herbicides, piraminni drugs were applied but the first one was soil application.

Postshoots application of herbicides was carried out in the phase of cotyledon - the first pair of true leaves of weeds. Fyuzilad Forte and Grand Lontrel were applied according to the recommendations in achieving the appropriate weed growth phase.

Table 1

Scheme of experiment of study the yield of sugar beets, depending on the system of herbicides application

№	Name of scheme	The schemes of herbicides application
1	Betanalna	1. Betanal Expert , e.c. (1,0 l/ha) + Holtiks, s.c (2,0 l/ha). 2. Betanal Max Pro , o.d. (1,5 l/ha) + Piramin Turbo,s.c. (3,0 l/ha). 3. Betanal Expert , e.c. (1,2 l/ha) + Torero, s.c. (2,0 l/ha). 4. Fyuzilad Forte,s.c (2,0 l/ha + Lontrel Grand, w.g (0,2 kg/ha).
2	Metamitronna	1. Torero , s.c. (2,0 l/ha) + Kontaktvin, e.c. (2,0 l/ha). 2. Holtiks , s.c. (2,0 l/ha) + Forte Belveder, s.c. (1,0 l/ha). 3. Torero , s.c. (2,0 l/ha) + Kontaktvin, e.c. (2,0 l/ha). 4. Fyuzilad Forte,s.c (2,0 l/ha) + Lontrel Grand, w.g (0,2 kg/ha).
3	Piraminnno holtiksova: 1st soil application	1. Piramin Turbo ,s.c (3,0 l/ha) + Frontyer Optima e.c (1,0 l/ha). 2. Piramin Turbo , s.c (3,0 l/ha) + Holtiks , s.c (2,0 l/ha). 3. Betanal Max Pro, o.d (1,5 l/ha) + Holtiks ,s.c (2,0 l/ha). 4. Fyuzilad Forte,s.c (2,0 l/ha) + Lontrel Grand, w.g (0,2 kg/ha).
4	Holtiksova	1. Holtiks , s.c. (3,0 l/ha) + Forte Belvedere, s.c. (0,8 l/ha). 2. Holtiks , s.c. (2,0 l/ha) + Kontaktvin, e.c. (2,0 l/ha). 3. Holtiks , s.c. (2,0 l/ha) + Betanal Maks Pro, o.d (1,5 l/ha). 4. Fyuzilad Forte, s.c (2,0 l/ha) + Lontrel Grand, w.g (0,2 kg/ha).
5	Piraminna: 1st soil application	1. Piramin Turbo ,s.c (3,0 l/ha) + Holtiks,s.c (2,0 l/ha). 2. Piramin Star , s.c. (2,0 l/ha) + Kontaktvin, e.c. (2,0 l/ha). 3. Piramin Star , s.c. (2,0 l/ha) + Betanal Maks Pro, o.d O (1,5 l/ha). 4. Fyuzilad Forte, s.c (2,0 l/ha) + Lontrel Grand, w.g (0,2 kg/ha).

In our studies the effectiveness of different systems of herbicides application by the way of determination of the residual herbicide weedery was compared after application of herbicides. Accounting was conducted in the third week of July, during the formation of the heaviest mass of weeds throughout the growing season.

The main material. Slow filling on the initial period of the growing season by the plants on field during the first 50–70 days after sowing, creates favourable conditions for weeds growth. In the conditions of sufficient moisture of the Western Forest Steppe almost every year there is a problem of summer repeated weedery due to effective three times application of herbicides.

Character of weedery sowing determines the ratio between the main biological groups of weeds, but the degree of weedery – the number of weeds (units./m²) and their mass (g/m²). Table 2 shows that dicotyledonous weeds were prevailed. Cereal weeds were absent on all variants, their number varies only within 0,3–0,7 units/m², but the mass is 10–19 g/m². It is explained by highly effective action of hraminitydu Fyuzilad Forte, which was applied on all variants for the control of cereal weeds after their mass shoots and formation of the desired weight. The application of herbicide Grand Lontrel allowed to control effectively the species of thistles, their presence at the time of keeping weeds was small (0,1–0,2 units/m² and 10–21 g/m²).

Among the indicators of weedery sowings except the number of weeds, the most important is their mass. According to V. M. Sinchenko [9], a larger number of weeds per unit of area by a small mass inflicts less damage for sugar beets than their large mass even with significantly lower density.

On the third variant (table 2) the combined piraminno-holtiksova system was investigated, where the first was the soil application but the next postshoot one. Basic herbicides there were Piramin turbo and Holtiks. On this variant there were the smallest number of weed plants and mass on per m², where these figures were respectively 2,1 units/m² and 104 g/m². This result provided the first soil application of herbicides namely Piramin Turbo (3,0 l/ha) + Frontyer Optima (1,0 l/ha). The scheme of herbicides application is presented in table. 2. Reducing of repeated summer weedery held both by soil application and on the application on this variant of highly efficient and selective drugs namely Piramin Turbo and Holtiks. As to the structure of weeds more than half belongs to *Polygonum convolvulus* L. and *Convolvulus arvensis* L.

On the fifth version as basic herbicides, piraminni drugs were applied. On this variant soil application of Piramin Turbo (3,0 l/ha) + Holtiks (2,0 l/ha) also provided better control of weeds, compared with the variants of schemes of post shoots herbicides application. Two times post shoots application of Piramin Star herbicide in the mixture with other drugs provided the pure of sowings on the third variant. The number of weeds are grown here only to 2,8 units/m², but their mass up to – 120 g/m², which is more only by 0,7 units/m² and 16 g/m² compared with the third variant (tabl. 2). The character of weedery on the fifth variant was almost the same as on the third variant.

On the first variant, post shoots system was applied with three times application of betanalnoyi group. Here the weedery was higher compared with the third and fifth variants due to the lack of soil application and other drugs. Thus, the number of plants increased to 5.8 units/m², but their mass – up to 219 g/m², compared with the first variant respectively by 3,7 units/m² and 115 g/m² more. It should be noted that unlike the third and fifth variants where basic herbicide was Piramin Turbo, the range of weeds has expended due to the appearance in the sugar-beet sowings the following weeds: *Chenopodium album* L., *Amaranthus retroflexus* L. and *Matricaria perforate* Merat.

Table 2

The level of weedery of sugar beets sowings of the hybrid CarltonRiven depending on the system of herbicides application, 2012–2014

Weeds species	Variants of herbicides application				
<i>Polygonum persicaria</i>	-	0,5/25	-	0,4/20	-
<i>Chenopodium album</i>	0,7/30	0,2/10	-	-	-
<i>Galium aparine</i>	-	0,2/10	-	-	-
<i>Amaranthus retroflexus</i>	0,6/28	0,8/30	-	0,5/20	-
<i>Thlaspi arvense</i> L.	0,2/10	-	-	-	0,2/10
<i>Convolvulus arvensis</i>	0,8/32	0,8/33	0,3/24	0,6/22	0,4/21
<i>Matricaria perforata</i> Merat.	0,7/20	0,7/22	-	0,6/20	-
<i>Cirsium arvense</i>	-	0,1/10	-	0,2/18	-
<i>Sonchus arvensis</i>	-	0,1/10	-	0,2/21	-
<i>Sinapis arvensis</i>	0,6/30	0,7/26	0,4/30	0,8/38	0,5/32
<i>Polygonum convolvulus</i>	1,4/40	1,7/46	1,1/40	1,5/44	1,0/38
<i>Polygonum lapathifolium</i>	0,4/15	0,4/18	-	0,6/20	-
Annual grasses: <i>Echinochloa crus-galli</i> , <i>Setaria glauca</i> and others.	0,4/14	0,4/12	0,3/10	0,6/18	0,7/19
Total	5,8/219	6,6/252	2,1/104	6,0/241	2,8/120

Numerator – units. /m² denominator – g/m².

On the fourth variant with the Holtiks scheme application, herbicides were applied post shoots, Holtiks was applied as basic. The number of weed plants is increased to 6,0 units/m², but their mass – up to 241 g/m², compared with the third variant by 3,9 items/m² and 137 g/m² more. On this variant, in addition to the *Amaranthus retroflexus* L. and *Matricaria perforata* Merat. were added *Polygonum persicaria* and *Polygonum lapathifolium* which are not observed in the third, first and fifth variants.

Post shoot metamitronna system was on the second variant, on which the Metamitron in the composition of Holtiksu and Torero was applied three times. There was the largest number of weeds, which increased to 6,6 units/m² but their mass – up to 252 g/m². Compared to the third variant the increase of weeds number is 4,5 units/m², and their mass – 148 g/m². Character of weedery was the same as on the fourth variant.

So, on all variants the most problematic weeds were found *Polygonum convolvulus* L. and *Convolvulus arvensis*.

The results of our researches showed a significant effect of schemes of herbicides application on the yield capacity of sugar beets.

The lowest yield (67,2 t/ha) of tubers was received on the second variant (table 3). Here after post shoots the basic herbicides of metamitronnoi group – Torero and Holtiks

were applied in the combination with betanalnoyu group: Kontaktvin and Forte Belvedere.

Table 3

The yield capacity of sugar beet of Carlton hybrid depending on system of herbicides application, t/ha.

№	Schemes of herbicides application	Years			Average years for 2012–2014 rr	Increase	
		2012	2013	2014		t/ha	%
1	Betanalna	73,2	62,7	75,4	70,4	3,2	4,8
2	Metamitronna	69,8	59,1	72,8	67,2	-	-
3	Piraminno-holtiksova : 1st soil application	78,4	68,4	78,6	75,1	7,9	11,8
4	Holtiksova	71,0	60,8	73,2	68,3	1,1	1,6
5	Piraminna: 1st soil application	74,0	63,7	84,5	74,1	6,9	10,3

NIR_{0,05} t/ha 1.89 1.31 2.31

The usage on the fourth variant of the post shoots of metamitronu application only with the Holtiks herbicide combining with the betanalnoyu group: Kontaktvin; Forte Belvedere and Betanal Max Pro favoured the increase of sugar beet yields to 68,3 t/ha, which is 1,1 t/ha or 1,6 % higher compared with the second variant.

On the first variant, the post shoots of herbicides application of betanalnoyi group was basic. Here the yield increased to 70,4 t/ha, compared with the second and fourth variants accordingly by 3,2 c/ha and 2,1 c/ha. The increase of the yield capacity compared with the second and fourth variants can be explained not only by highly efficient action of betanalnoyi group but the fact that they were reinforced on this variant, during the first and second application of high selective drugs Holtiks and Piramin turbo. During the third application by Betanalu Expert partner was used the Torero herbicide, acting ingredients of which are characterized not only by systematic action through leaves but good soil action. As a result weedy of sowings were decreased in the second half of the growing season.

On the third and fifth variants, unlike other variants of the experiment, the first application of herbicides were soil application, thereby it favoured the yield increase. The use on the fifth variant of the system of herbicides application on the bases of piraminnyh drugs – Piramin turbo, Piramin Star in combination with Holtiks and herbicides of betanalnoyi group Kontaktvin and Betanal Max Pro, increased the yield of sugar beet up to 74,1 t/ha, which is higher compared to the second variant by 6,9 t/ha or 10,3 %. It should be noted that the soil application of the mixture of two herbicides – Piramin Turbo + Holtiks had a positive effect too. The increase of yield capacity for the fourth variant is 5,8 t/ha (8,5 %), for the first one – 3,7 t/ha (5,3 %).

The highest yield (75,1 t/ha) in our researches was received on the third variant, where the first application of herbicides were soil one (Piramin Turbo + Frontyer Optima) and basic drugs were piraminno-holtiksova group. On the third and fifth variants the summer weedery almost was not (table 2). The yield capacity on the third variant exceeded the second variant by 7,9 t/ha (11,8 %), the fourth one – by 6,8 t/ha (10,0 %), the first one – by 4,7 t/ha (6,7 %), the fifth one – by 1,0 t/ha (1,3 %).

Conclusions. The most effective system for weeds control in the second half of the growing season proved the system of herbicides application based on drugs of piraminno-holtiksovoyi group, which included the application four times:

- 1 application – Piramin Turbo, s.c. (3,0 l/ha) + Frontier Optima, e.c. (1,0 l/ha);
- 2 application – Piramin Turbo, s.c. (3,0 l/ha) + Goltiks, s.c. (2,0 l/ha);
- 3 application – Betanal Maks Pro, o.d. (1,5 l/ha) + Goltiks, s.c. (2,0 l/ha);
- 4 application – Fiuzilad Forte, s.c. (2,0 l/ha) + Lontrel Grand, w.g. (0,2 kg/ha).

The highest yield of sugar beets (75,1 t/ha and 74,1 t/ha) obtained on the variants where the first application of herbicides was soil. Piraminni drugs provide higher efficiency compared to metamitronnomy.

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THE PERMANENT GROWING OF SUGAR-BEET

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P. 48–51. Bibl. 6.

The formulation of the problem. We know that only with proper crop rotation can be created the most favorable conditions for the effective use of fertilizers, tillage systems and measures to protect plants from weeds, pests, diseases, improving and maintaining soil fertility, the formation of high yields and quality of crop production.

Among row crop, the sugar beet is one of the most exacting cultures to crop rotation. As D. Shpaar notes, the German agriculture due to the profound intensification of land use (primarily the use of high doses of mineral fertilizers etc.) expanded the area under maize and sugar beet. These changes had a negative impact, particularly because of simplifying crop rotation disrupted soil biological activity and decreased the content of humus.

The approaching of sugar beet crops in the crop rotation has a negative impact on the balance of nutrients in the soil, microflora activity, phytosanitary condition of the soil and crops, stocks of productive moisture. A substantial role is assigned predecessors and before predecessors. At high moisture reserves in the soil, applying the required rate of fertilizers and pesticides, the use of highly productive grades, combined with good tillage, planting and caring for crops the concentration of sugar beet in the crop rotation can be increased. These preconditions allow you to enter special simplified crop rotation that is saturated rich culture.

The presenting main material. In the inpatient long-term experiment of Lviv National Agrarian University since 1964 have been holding study the permanent sugar-beet growing on agronomic properties of soil, weediness and productivity of cultures. The soil of research area is dark gray, ashed, medium-loamy. Frequency – three times. The scheme of the experiment is shown in Table 1.

Table 1

The crop capacity of permanent growing of sugar beet depending on fertilizing systems and applying herbicides, kg/ha

System of fertilization	Protection against weeds	Harvest by year		
		2013	2014	2015
N ₉₅ P ₉₀ K ₁₂₀ + 15 t/ha manure	without herbicides	264	216	374
	with herbicides	304	253	440
N ₁₇₀ P ₁₃₀ K ₂₀₀	without herbicides	202	135	196
	with herbicides	235	192	230

As the results of the research showed, permanent crops of sugar beets had a lot of weeds on all variants of the experiment. Thus, during complete stairs all variants without using herbicides were very clogged – 277–314 pieces/m². The efficiency of soil herbicide «Dual Gold» was high – the quantity of weed in the crops decreased several times to 26–29 pieces/m².

In respect of fertilization system, then the combined use of organic and mineral fertilizers quantity of weeds was growing and explaining by the best conditions of plant growth and using of organic fertilizers which are known to contain significant amounts of weed seeds. The use of herbicides, inter-row cultivation, and competitiveness of sugar beet plant helped reduce weediness of crops at the time of closing of rows to 14 – 64 and before harvest to 9 - 46 pieces/m². A number of weeds in areas without herbicides were almost 4 times higher.

In sugar beet crops prevailed following weeds: *Chenopodium album*, *Echinochloa crus-galli*, *Galinsoga parviflora*, *Amaranthus retroflexus* L., *Persicaria lapathifolia*.

Our research found that the average for the 2013 – 2015 biennium crop capacity of sugar beet during permanent growing was 178–332 kg/ha and significantly dependent on agrometeorological conditions of the year (table 2). In particular, their productivity was the highest in 2015 – 196–440 kg/ha. The use of organic-mineral fertilizer system provides premium 107–113 kg/ha of root crops compared with only mineral fertilizer, and the versions without chemical control weed beet productivity are reduced by 16–23 %.

Table 2

Correlation the main and by-products of sugar beets, the average for the years 2013–2015

System of fertilization	Protection against weeds	Crop capacity, c/ha		Correlation main/by-products
		roots	tops	
N ₉₅ P ₉₀ K ₁₂₀ + 15 t/ha manure	without herbicides	285	91	1:0,37
	with herbicides	332	100	1:0,30
N ₁₇₀ P ₁₃₀ K ₂₀₀	without herbicides	178	110	1:0,62
	with herbicides	219	136	1:0,49

After fertilization by N₉₅P₉₀K₁₂₀ and 15 t/ha manure for sugar beets, on one part of the main products accounts for 0,3–0,37 part of the top, and in areas of application N₁₇₀P₁₃₀K₂₀₀ resulting in a reduction of productivity growth of roots and leaves of beets, the ratio is 1 : 62 and 1 : 49.

Conclusions. In the western steppes of Ukraine, the long-term permanent cultivation of sugar beet combined using of organic and mineral fertilizers is more justified than mineral fertilizer system, as it helps improve soil fertility and productivity roots.

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POTATO PRODUCTIVITY DEPENDING APPLICATION OF GROWS REGULATORS FOR SEED TUBERS' TREATMENT

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Problem statement. Sure, potato was and will be one of main food crop for world population. Thus attention of researchers and practitioners to increase of its productivity, quality of tubers for consumers, sustainable against diseases and stress factors of environment is regular and stabile.

Biologization of agrarian production and increase of crops productivity is very important issue. Foreign and Ukrainian researchers are searching of unused reserves (fertilization, effective crop protection, new higher-productivity varieties etc), which allow decrease chemical pressing on environment, improve edaphic conditions and increase production of environmentally-friendly products.

Potato is crop that form yield in soil, thus has especially requirements for soil characteristics. Correction of existing growing technologies is necessary at extreme conditions for plants life (unfavourable temperature, prolonged drought, lack and excess of soil humidity, hail etc).

Environment has regular influence on plant. It changes speed and ways of metabolism and direction of growth processes. Quantity and quality of yield are determined as results of combination of environmental parameters and vegetation period. Thus in potato production need to use some measures directional on change of controllable environmental factors and biological features of plant. Physiology-biochemical processes be different may even in varieties with different bioecological features. Experience of potato growing shows that in zones with favourable soil-climatic conditions the high yield may obtain by wider application of ecologically safe and effective stimulation substances and biopreparations.

Thus, development of some elements of use of growth regulators of plant and biological preparation in growing technologies of potato is actual and needed for formation of ecologically safe and stability yield.

The problem of effectiveness of biopreparations' application, in particular Emistym C, Biolan and Poteitin, during growing of high productivity, intensive variety Volya is very important.

Analyze of recent research and publications. For increase of potato productivity is used different organizational and technological measures, breeding and seed production. Application of growth regulators and biopreparations is important component for intensification of potato production [1; 3; 4; 5; 7; 8].

Today synthesized many chemical substances by which may activity influence on morphological processes in plant. Part of them has practical application. But growth regulators yet don't have wide use in potato productivity.

Research in different edaphic and climatic conditions confirm improve of biological and economical features of crops at application of growth regulators. Addition yield of potato tubers at application of growth regulators are achieved 20 – 30 % and more [9].

Task statement. The aim of our research was studying influence of Emistym C, Biolan and Poteitin by treatment of seed tubers on biometrical, physiological features and productivity of potato variety Volya. During 2014–2015 in field condition of Lviv National Agrarian University was carried experiment.

Results. Assessment of plants showed that application of growth regulators has positive influence on growth and development of potato.

Obtained results showed that use of growth regulators in growing technology provide activation of growth and physiological processes in plant. Seed tubers treatment by growth regulators was promoted to increasing of height, density plantings, increasing of area of leaves surface. Between increasing of content of chlorophyll and dry substance in leaves and synthesis of assimilates is direct correlation. Thus in plants more intensively occur physiological and biochemical processes that influence on formation of its productivity. Furthermore we observed more active passing of physiological phases, reducing of period of seedling and budding when beginning formation tubers from stolons.

In experiments variants amount of commodity tubers from bush was 8,4–8,6 pieces (table 1). Commodity of tubers increased comparatively to control on 0,9–1,1 pieces.

Table 1

Fractional composition and commodity of potato tubers

Variant	Tubers from bush, pcs.	Amount of tubers, pcs.			Commodity tubers, pcs.	Commodity tubers, %
		less 30 g	30-80 g	more 80 g		
Control (water treatment)	11,2	3,1	3,7	4,4	7,5	67,0
Emistym C (2,5 ml/t)	11,9	3,2	3,8	4,9	8,4	70,6
Biolan (3 ml/t)	12,0	3,1	3,8	5,1	8,4	70,0
Poteitin (100 mg/t)	12,2	3,0	4,0	5,2	8,6	70,5

Potato productivity of variety Volya in experiment was high. In control this index was from 561 g/bush (2015) to 586 g/bush (2014) at average productivity 573 g/bush. Plant productivity in variants with growth regulators was from 592 g/bush (2015) to 627 g/bush (2014) at average productivity 598–621 g/bush. Higher productivity was in variant with seed tubers treatment by Poteitin.

The results of research showed that potato yield in all variants with growth regulators application was higher comparable to control (table 2). Poteitin application was the most effective. In control in average on 2 years the yield was 226 c/ha, in variants with growth regulators – on 20–33 c/ha more (9–15 % more).

Table 2

Potato productivity in depending growth regulators

Variant	Year, c/ha		Average, c/ha	± to control	
	2014	2015		c/ha	%
Control (water treatment)	231	221	226	-	-
Emistym C (2,5 ml/t)	257	235	246	+20	+9
Biolan (3 ml/t)	261	240	251	+25	+11
Poteitin (100 mg/t)	266	251	259	+33	+15

Thus growth regulators application significantly influence on potato yield, in particular on variety Volya.

Conclusions. Seed tubers treatment by growth regulators promoted increase height, density plantings, area of leaves surface, reduce of period of seedlings – budding are established.

Growth regulators application promoted to tubers quality formation. Increasing of tubers commodity to 70,5 % that on 3,5 % more than control was achieved with seed tubers treatment by Poteitin.

The most yields were obtained at Poteitin treatment of seed tubers at rate 100 mg/t. During research years the yield of Volya was 259 c/ha and addition to control was 33 c/ha.

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POTENTIAL YIELD OF WINTER WHEAT VARIETIES ZOLOTOKOLOSA DEPENDING ON RECEIPTS PHOTOSYNTHETIC ACTIVE RADIATION ON DARK GRAY ASHED SOILS OF WESTERN FOREST STEPPE OF UKRAINE

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Bibl. 4. P. 56–59.*

Formulation of the problem. The problem solved by increasing grain production, mainly due to the further significant increase in productivity of arable land. A new trend in agronomic science and agricultural practice– programming yields contributes for this.

Programming of yields based on the principle of establishing of the possible level of productivity, if determined by biological characteristics of culture (variety) and climatic conditions (agriculture), on the one hand, and targeted adjustment process forming part – on the other hand [2]. The potential yield – the highest level of yield, defined the arrival of photosynthetically active radiation (PAR), under ideal weather and farming conditions depends on the biological characteristics of culture and class. [3]

The main material. In the agricultural service cooperative "AGRO Pukiv" Rohatyn district, Ivano-Frankivsk region dominated by dark gray ashed soils. The content of mobile forms of nitrogen, phosphorus and potassium in the soil this is: 140 mg of easily hydrolyzed nitrogen, 130 mg of mobile phosphorus and exchangeable potassium 150 mg per 1 kg of soil.

When using this formula sums indicators of PAR ($\sum Q$) during the growing season we were taken to the zonal agrometeorological station (m. Ivano-Frankivsk). Utilization of PAR (KQ) for different varieties of winter wheat may vary depending on plant biology, soil fertility, applied agricultural technology and other factors. According to the average values of the coefficient of of PAR (KQ) winter wheat sowings can be divided into: normal – 1 %, good – 2 % and very good – 3 %.

According to the calculations of basic products to the side and standard humidity of winter wheat using the following parameters: the ratio of primary products to the side Products of 1 : 1.4, sum of the parts the main products and by-products for the 2.4 at standard humidity of 14 %.

According to scientific advice sowing winter wheat within boundaries of Rohatyn district, Ivano-Frankivsk region recommended to do on 20–25 September (in the calculation of the date – 20 September). In this case there will be stairs approximately after 8–10 days, namely on 28 September – 4 October, in the calculations we take the date of 30 September. Autumn vegetation stops on 6–10 November (in the calculations we take November 6). Spring vegetation begins on March 25 – April 1 (in the calculations the date – 25 March). Harvesting in these conditions is carried out 20 – 30 July (in the calculations we take – 25 July). By using the above data, we can calculate PAR, which comes during the growing season 159 days – 126.79 kJ.

Accumulation of solar energy in kJ/t by or kcal/t by winter wheat according to generalized data of scientists as follows: whole plant – $18,63 \times 10^6/4,44 \times 10^6$, the main products – $15,05 \times 10^6/4,54 \times 10^6$, by-products – $18,00 \times 10^6/4,29 \times 10^6$ and root system – $17,17 \times 10^6/4,09 \times 10^6$.

The calculation of the potential crop to arrival of PAR 1, 2 and 3 % calculated by the formula:

$$1) \text{ ПУ} = \frac{\sum Q \times 10^8 \times K_c}{10^2 \times C} = \frac{126,79 \times 10^8 \times 1}{10^2 \times 19,26 \times 10^6} = 6,6 \text{ t/ha};$$

$$2) \text{ ПУ}_o = \frac{\text{ПУ} \times 100}{(100 - B_c) \times \Sigma_u} = \frac{6,6 \times 100}{(100 - 14) \times 2,4} = 3,2 \text{ t/ha};$$

$$1) \text{ ПУ} = \frac{\sum Q \times 10^8 \times K_c}{10^2 \times C} = \frac{126,79 \times 10^8 \times 2}{10^2 \times 19,26 \times 10^6} = 13,2 \text{ t/ha};$$

$$2) \text{ ПУ}_o = \frac{\text{ПУ} \times 100}{(100 - B_c) \times \Sigma_u} = \frac{13,2 \times 100}{(100 - 14) \times 2,4} = 6,4 \text{ t/ha};$$

$$1) \text{ ПУ} = \frac{\sum Q \times 10^8 \times K_c}{10^2 \times C} = \frac{126,79 \times 10^8 \times 3}{10^2 \times 19,26 \times 10^6} = 19,7 \text{ t/ha};$$

$$2) \text{ ПУ}_o = \frac{\text{ПУ} \times 100}{(100 - B_c) \times \Sigma_u} = \frac{19,7 \times 100}{(100 - 14) \times 2,4} = 9,5 \text{ t/ha}.$$

Over the past three years (2013–2015 gg.) in this sector yield of winter wheat was as follows: 2013 – 5.8 t/ha, in 2014 – 6.0 t/ha and 2015 – 6.3 t/ha.

Conclusions. During the cultivation of winter wheat of a variety Zolotokolosa on dark gray ashed soils of Western steppes of Ukraine after predecessor Viko-oat mixture by the utilization rate of PAR 1, 2 and 3 % can be obtained potential yield of primary products at standard humidity 14 % 3.2, 6.4 and 9.5 t/ha and also provide other factors during the growing season. The crop of winter wheat biomass depends on the utilization rate of PAR. In our researches in the 2015 winter wheat yield of 63 c/ha responsible to coefficient of PAR 2 %. These crops of winter wheat according to the existing classification can be attributed to good.

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FORMATION OF *CALENDULA OFFICINALIS* L. PRODUCTIVITY DEPENDING ON APPLYING GROWTH STIMULANTS AND SOIL AND CLIMATIC CONDITIONS OF CULTIVATION

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Bibl. 12. P. 60–65.*

Formulation of the problem. *Calendula officinalis* L. (marigold) is an important annual herb of the Asteraceae family, which is widely used in various fields of medicine. Marigold flowers possess anti-inflammatory, antiseptic, antispasmodic, wound healing, sedative, diuretic, chologogic actions. In Ukraine this plant is grown only in culture, so the increasing of its productivity is an important prerequisite for the industrial cultivation of *Calendula officinalis*.

The aim of research was to study the effect of plant growth regulators “Vermistim”, “Vermibiomag” and “Vermiiodis” on the productivity of *Calendula officinalis* (“Field beauty” variety) in different soil and climatic conditions of cultivation, in particular, in Precarpathian region and Western Forest-steppe of Ukraine.

The “Field beauty” variety is explored for the first time under Precarpathian region and Western Forest-steppe (Lisosteppe) of Ukraine conditions.

The study was carried out during 2015 on the dark-grey podzolic middle loamy soils of the Western Forest-steppe of Ukraine (on the field of educational and scientific research centre of Lviv National Agrarian University (LNAU)) and sod-podzolic soils of Precarpathian region (on the research field of Ivan Franko Drohobych State Pedagogical University (DSPU)). The chemical composition of field soil of educational and scientific research centre of LNAU is somewhat richer in proportion comparing with soil of research area of DSPU.

Repeated experiment was carried out for three times. The accounting area was 10 ml.

Plant growth stimulants were applied in two stages: the first one – in the phase of the sprout, the second one – in the budding phase. Application rate was 5 l/ha.

Description of the main material. To assess the effects of growth stimulants on the productivity of *Calendula officinalis* of the “Field beauty” variety some morphometric indices of plants were measured, namely the average plant height (cm), the number of flower heads (capitulum) on the plant (units), inflorescence diameter (cm) and flowers yields (cwt/ha).

These highest indices were found in variants with applying of “Vermibiomag” and somewhat lower with applying of “Vermiiodis”. The lowest morphometric indices were found in control variant (without applying stimulants) in the Western Forest-steppe and Precarpathian region of Ukraine.

The highest flowers yields were in the variant, in which the marigold plants were sprayed with plant growth regulator “Vermibiomag”. Under the Western Forest-steppe conditions this index was $11,3 \pm 0,6$ cwt/ha, and under the conditions of Precarpathian region – $10,8 \pm 0,6$ cwt/ha. The lowest flowers yields were found in control variant – $8,6 \pm 0,4$ cwt/ha and $7,9 \pm 0,3$ cwt/ha respectively for the mentioned regions. The growth stimulants “Vermistim” and “Vermiiodis” also exerted the significant effects on the *Calendula officinalis* flowers yields.

The productivity of *Calendula officinalis* plants under conditions of Western Forest-steppe was somewhat higher than under conditions of Precarpathian region of Ukraine.

Conclusions. The plant growth stimulants “Vermistim”, “Vermibiomag” and “Vermiiodis” exerted the evident effects on the *Calendula officinalis* productivity of “Field beauty” variety. The best results were obtained in the variant with applying the biostimulant “Vermibiomag”, and the lowest ones – in the control variant.

The soil and climatic conditions also influenced the morphometric indices and *Calendula officinalis* flowers yields.

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CHAPTER 4 FRUIT AND VEGETABLE GROWING

THE APPLICATION OF BIOLOGICAL PRODUCTS AT CULTIVATION OF TOMATOES SEEDLINGS IN THE OPEN GROUND

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Bibl. 9. P. 66–73.*

Formulation of the problem. Creating optimal agroecological and technological preconditions helps in getting high and stable yield of crops. Due to comprehensive greening of agriculture we should use alternative approaches that consider a restriction of the use of chemical plant protection products and the widespread introduction of biological methods combined with adapted elements of cultivation technology [6].

It is known that biological preparations affect on the growth and development of vegetables, increase seed germination, particularly in the beet and radish on 5–10 %. As a result of plant cultivation using biological products they are characterized by maximum leaves length, the surface of the leaf blade, diameter of the root. According to the researches of N.N. Naplekova spraying the plants with biological products provide an increase of roots yield by 20–65 % [5]. For the indicators studied the effectiveness of the biopreparations found in «BakSib». Also, biologicals affect on rhizosphere microbial communities, reduce soil phytotoxicity, improve absorption of nitrogen and phosphorus [4]. The use of biopreparations that are based on nitrogen-fixing and phosphate-mobilizing bacteria promote earlier flowering and harvest increase by 23,0–33,5 % [8].

The planting term and processing potato using phytocide and planzyr affects the yield of plants. During the growing Skarbnytsia variety yield of tubers is decreased by 2,9 – 3,2 t/ha depending on the planting term, and on Oberig variety, difference of yields of the first term and the third was 7,5 t/ha [3]. The use of biologicals Mizorin and Ahrika during pre-processing of potatoes increases the overall yield and marketability in 0,9–1,2 t/ha. Processing plants using biological and chemical preparations affect biochemical processes in tissues, particularly in the enzymatic activity. Growing activity of redox enzymes in the leaves of the tomato increases the protective reaction of the plant, increases the ability to opposite phytopathogen infection and other adverse factors of the environment. O.D Chernihina found that the use of azotobakteryn 9T increases the activity of catalase in tomatoes by 14,5 % [9].

In the studies of A. G. Tarnavskiy [7], the treatment of cucumber seedlings using Azotophyte and Phytosporyn affects on biometric indicators in the flowering stage and mass fruiting. For the height of the main stem and leaf surface area, treated seedlings were characterized with greater stems height and leaf surface area increased by 129–192 cm². In mass fruiting phase, difference of height of the main stem treated with

biopreparation was greater by 7,8–9,9 cm, plants formed more leaves, and their area increased by 152–184 cm². The highest yield was obtained using Azotophyte – 42,7 t/ha, lower profits of marketable yield obtained from the use of Phytosporyn.

Barbakar A. V. proved that increasing of concentration of Azotophyte or Phytocide while soaking seeds increases productivity of tomato. Soaking seeds using Azotophyte in concentration of 1 ml/10 l increases the yield of tomato fruits to 46,2 t/ha. At the same time, Phytocide increases dry matter content from 4,8 % to 5,3 %, sugar – by 15–24 %, reduce nitrate levels by 30 % [1].

Results. Among the studied sorts best indicator of height characterized by a sort of tomato Lyana. As a result of the growing sort and use of Azotophyte height of plants after planting in open ground was – 18,9 cm, and on Phytocide – 18,3 cm, that was higher than the height of plants that are not treated with biopreparation on 3,8 cm and 3,2 cm. In phase "bloom" and formation of fruits, plants were the highest when treated using only Phytocide. However, in the phase of "bearing" sort Lyana with use of Azotophyte was the highest and amounted to 52,7 cm higher than the height of plants and control. In these phase characterized by lower height plants that were processed using Phytocide and they exceeded the control rate only on 2 %.

Approximate response on the use of biologically found in a sort Lahidnyy. The test plants exceeded the performance control at phases "bloom" and "bearing", and the difference in height of plants treated with Azotophyte was 3,2 cm and 3,9 cm and the Phytocide – 2,2 cm and 3,2 cm. By Novychok and Rio Grande sorts plant height was less than the control variant. Number of fruits with the usage of Azotophyte and Phytocide ranged from 3 to 6 pc in I-IV brush and changed the value of both upward and downward. Most number of fruits obtained from the use of Azotophyte and Phytocide to sort Rio Grande, and only Azotophyteu to sort Lahidnyy. In these variants, the amount of fruit in brushes increased by 1–2 pcs.

Power of assimilation system and resistance to damage is the basis for the timely passage of photosynthesis which affects the reception quality of the crop. In phase "bloom" during the growing sort Lahidnyy we defined biological positive effect on increasing leaf surface. As a result of Azotophyte application leaf surface area was – 7,0 thousand m²/ha, and on Phytocide – 5,2 thousand m²/ha, that was higher then leaf surface area of control on 4,4 thousand m²/ha and 2,6 thousand m²/ha. In the phase of "bearing" leaf area significantly increased and ranges 20,0–15,2 thousand m²/ha. However, the leaf surface on sorts Lyana and Rio Grande was inferior or varied to control from the use of biologicals.

The weight of the fruit in the study was characterized by varying the size and changed depending on the applied biological preparation. Sort Lyana was characterized by the toughest fruit when treated with Azotophyte. The value of weight in this variant accounted to 92,0 g and 21,6 g that was larger than option where the plants are not treated. At the same time, the use of Azotophyte or Phytocide increases fruit weight of sort Lahidnyy by 11,8 g and 5,2 g. Also on the sort Novychok weight increases and exceeds the control rate of 7 g for the use of Phytocide and 9 g for the use of Azotophyte. Treating plant sort Rio Grande with Azotophyte increased fruit weight by 15 %.

The level of productivity indicates adaptability of elements of technology,

establishing dependency class to appropriate soil and climatic conditions. For years of research, on the value of the harvest tomatoes affect grade, biological, soil and climate conditions, growing technology. In 2012 from the use of biologicals tomato yield ranges from 28,3 to 55,2 t/ha. High grade indexes were characterized by Lyana and Lahidnyy as a result of Phytocide application and Rio Grande for use of Azotophyte. Analysis of yield in 2013 identified that the highest value on the sort Lyana, Novychok and Rio Grande was reached using Azotophyte treatment. The size of the yield varies from 50,8 to 53,3 t/ha. In 2014 the yield is much inferior to previous years and was only 18,6–30,5 t/ha. With increased yield characterized sorts Novychok and Lahidnyy when processing plants using Phytocideom.

During the growing sort Lyana with application of Azotophyte, the overall yield for the years of experiment increased to 42,0 t/ha, and the application of Phytocide – up to 37,6 t/ha. Sort Novychok characterized with smaller yields with plants which were treated using Azotophyte. The difference in yield to the control was 4,5 t/ha, and the least – obtained by growing the sort Rio Grande from the size of 36,2 t/ha with the use of the biological product. As a result of the cultivation of tomatoes in open soil conditions high marketability sort of tomato is Lahidnyy. From application of Azotophyte marketability grade was 74 % and 66 % on sorts Lyana and Novychok.

The process of growing tomato production is quite energy intensive. During the growing sort of tomato Lyana total energy that was spent on production ranged from 27803,1 to 33174,1 MJ/ha. The highest energy obtained in the variant using Azotophyte. The energy index was greater than control to 1,2 times. The energy spent in the cultivation of the sort Lahidnyy when spraying using Azotophyte was also 1,2 times higher than the energy in control variant.

Calculations revealed that much more energy is obtained in option by using Azotophyte on sort Lyana. Excess against the control was 18428,2 MJ/ha. Less energy obtained from the growing variety Lahidnyy when processing plants using Azotophyte and Phytocide. The coefficient of efficiency of bioenergy while growing tomatoes was determined with effectiveness of the biological product and it fluctuated within 1,63-1,78 and depended on yield, yield increases with increasing study rate and vice versa. The most value of the coefficient is derived from the cultivation of the sort Lyana with use of Azotophyte, amounting to 1,78, and the least – in a sort Lahidnyy in option where biologicals are not used with the value of 1,63.

Summary. 1. Biological preparation Azotophyte can stimulate the growth and development of plants of sorts Lyana and Lahidnyy; accelerate flowering and ripening on the plant for 2 – 3 days; helps in increasing weight of sort Lyana, Lahidnyy, Novychok and Rio Grande at 4,0 – 21,6 g.

2. During the growing sort Lyana with use of Azotophyte, the total harvest increased to 42,0 t/ha, bioenergy efficiency ratio is 1,78, and from spraying with Phytocide yield increased to 37,6 t/ha.

3. Sort Lahidnyy characterized with high grade of tomato marketability. With use of Azotophyte marketability increased to 74 %, when treatment was performed 2 times in seedling period and 3 times during cultivation in an open ground.

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THE YIELD CAPACITY AND QUALITY OF BUNCHED PRODUCTS OF BEET DEPENDING ON THE TYPE COVERINGS AND SOWING

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Bibl. 4. P. 66–73.

The formulation of the problem. The program of development of the industry of horticulture field is planning to increase vegetable production and expand its range. It should take into account the varietal characteristics of culture, the period of sowing, soil and climatic conditions of cultivation of this crop, and others. In recent years, the special attention deserves a production of bunched products using covering and different seeding time. To speed up the germination of seeds is considered effective a cover of agrofibre or polyethylene film. In the spring, when we have the external temperature fluctuations, under that coverings conditions are favorable for germination and intensive plant growth. They use economically spring moisture reserves.

The main material. Field experiments were conducted during 2009 – 2013 years on the fields of Educational Research Center of the Lviv National Agrarian University with a variety of beet "Dij". Sowing: close to winter, early spring. Type of covering: polyethylene film, agrofibre. The exposure of slope is south-eastern. Soils of research areas are dark gray-ashed, medium loam.

The beet of close to winter sowing was sown before the freezing ground (the third week of November – the decade of December), and early spring period – from the onset of ripening soil. The close to winter sowings was covered by an agrofibre and a polyethylene film after a full thawing of the soil, and early spring immediately after sowing the seeds. The crop collected selectively to the achievement root diameter of at least 2.5 cm. Plants of beet cleaned and tied in bundles.

Depending on the type of covering and terms of sowing the biochemical composition varies both in the leaves and in the roots. Under covering with polyethylene film in the close to winter sowing in the roots accumulated a high dry matter content (14.1 %), followed by early spring sowing their content in the leaves of the highest – 12.2 %. The amount of sugars in the roots of bunched products is the highest in the close to winter sowing without cover (9.6 %), and are covered with a polyethylene film – 9.5 %. In the leaves the amount of sugar varies from 7.1 to 8.6 % depending on the cover and sowing. The elevated levels of protein observed in plants in early spring sowing under agrofibre.

It should be noted that the highest cellulose content in the plants of bunched products are formed by early spring sowing without cover. It is important to note that the cellulose content in all variants research more in leaves than in roots.

In the bunched products contents of nitrate products regardless of the type of covering and sowing was lower in all versions of the experiment and did not exceed the maximum permissible level (1400 mg/kg), but in leaves were less than in roots.

As a result of the research was obtained different number of bunched beet depending on covering and sowing.

Thus, on average three years, the highest crop was obtained under cover with a polyethylene film by early spring sowing – 83.0 thousand pieces on a hectare of bunches. Without cover for all of the sowing obtained the lowest crop which was almost half of less the figure for the close to winter sowing without covering (48.8 thousand pieces on a hectare of bunches). It should be noted that for the close to winter sowing the crop comes before the sowing of early spring and implemented it at higher prices. It is accordingly affected the profitability.

These data show that the highest level of profitability obtained by growing beet in polyethylene film for sowing the winter (193.3 %). In the version without cover (control) was received significantly lower profitability on 143.3 and 120.7 %.

Conclusions. The high crop of bunched products provides early spring terms and cover with polyethylene film. However, profitability is higher (193.3 %) for the close to winter sowing. The biochemical composition of bunched products depends on how the term of sowing, cover type, and from the productive part of the body.

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THE INFLUENCE OF SYNTHETIC GROWTH REGULATORS 1-NAA AND 6-BAP ON THE MORPHOGENESIS AND THE PRODUCTIVITY OF SWEET PEPPER

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Bibl. 10. P. 77–81.

Problem formulation. One of the central directions of solution of the problem of getting high and stable yields in plant growing is the applying the intensive technologies with using the synthetic growth regulators. The using of these preparations allows to regulate directly the separate stages of plant ontogenesis for the purpose of mobilization the potential opportunities of the plant organism. The using of growth regulators is the new direction of agrobiology which based on the modern achievements of fitophysiology, molecular biology and biochemistry.

The main part. It is known that substantial role in formation of plant productivity plays the amount of leaves and the area of the leaf surface. The given results of the investigation suggests that in the phase of fruiting under the influence of synthetic growth regulators 1-NAA and 6-BAP the amount of leaves and its total area on the plant and mass of wet substance of leaves have increased.

It is known that the important indicator of plant productivity is the specific mass of the leaf. The positive correlation between the intensity of photosynthesis and its indicator explained the increasing of concentration of the main structural components and pigments under the direct participation of which the assimilation of carbon dioxide has carried out. It is investigated that by means of preparations this indicator was higher in comparison with control variant. It is found that the increasing of this indicator by means of these preparations connected with structural features that determined as a mesostructure. It is possible to analyze by mesostructural characteristics photosynthetic activity of plants in many cases, but during the study the influence of 1-NAA and 6-BAP on the formation of the photosynthetic apparatus of leaves of sweet pepper wasn't conducted.

The given results suggest that by means of preparations has formed more powerful photosynthetic apparatus.

The substantial increasing of thickness of the leaf has occurred by formation the photosynthetic tissue – chlorenchyma as a result of increment the linear sizes and the volume of cells of column and spongy parenchyma.

The given results suggest that by means of preparations the content of the sum of chlorophylls has increased ($a + \epsilon$). During the cultivation of peppers by 6-BAP the content of chlorophylls was $0,85 \pm 0,04 \%$, and under the influence of 1-NAA – $0,81 \pm 0,04 \%$ against $0,73 \pm 0,03 \%$ in a control variant.

Therefore, the using of the synthetic auxin (1-NAA) and the synthetic cytokinin (6-BAP) led to the more developed photosynthetic apparatus which allows to plant to form a powerful donor potential and is the prerequisite of increasing of yielding capacity of culture.

The important coenocytic characteristics of plant productivity are leaf and chlorophyll indexes. The given results suggest that by means of preparations increase the leaf index of the plant. The increasing of the area of leaves of plant and the content of chlorophylls in its by means of synthetic auxin and cytokinin led to the increasing of chlorophyll index.

Therewith, the increasing of the area of the leaf surface in coenosis can't be the positive feature as during thickening of sowings it is possible the shading and the reduction of photosynthetic activity. The given results of investigation suggest that the processing by preparations hasn't led to the negative effect. By means of 1-NAA and 6-BAP has noted the reliable increasing of yielding capacity of sweet pepper as from one bush so from one unit of area of plantations (tab. 3). More effective was the using of 6-BAP.

Conclusion. Therefore, the using of preparation 1-NAA with the auxin mechanism of action and 6-BAP with cytokinin mechanism led to the formation of more powerful photosynthetic apparatus of sweet pepper, leaf and chlorophyll indexes which led to the increasing to the yielding capacity of culture.

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INNOVATIONAL CONSTITUENTS OF STABLE DEVELOPMENT OF VEGETABLE CULTIVATION BRANCH IN KHARKIV REGION

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Bibl. 7. P. 82–86.

Topic. Vegetable cultivation is a priority branch of agriculture in Kharkiv region, with its share in crop cultivation is around 11.8 %. Research work in vegetable and melon cultivation in Ukraine is coordinated by Institute for Vegetable and Water-Melon Cultivation of NASUA, located in Kharkiv. Its scientists and network of research stations have made great effort in creating new cultivars and hybrids of vegetables and developing of modern growing technologies. Today Kharkiv region is among the top three regions of Ukraine in terms of vegetable production output, but, as we see, it does not provide its inhabitants with its production. To eliminate this flaw and to increase export volume “Program of vegetable and potato cultivation and processing industry development until 2020”. Vegetable subcomplex is one of constituents of food security formation, but some aspects of current state of vegetable cultivation innovational development in Ukraine are insufficiently studied and that led to the choice of topic of this publication. The aim of this research is to determine main innovational constituents of vegetable production considering many factors to increase productivity.

Summary. Vegetables cultivation is a priority branch of crop cultivation in Kharkiv region. Year-round provision of population with quality vegetables is of a high social significance because vegetables have valuable nutritious and healing features, help digesting another foodstuff and are an important source of easily digestible carbohydrates, proteins, vegetable fats, vitamins, organic acids and mineral salts. Vegetable cultivation widely uses seedling method for growing vegetables that allows to accelerate crop yield or to grow vegetables with a long growing season. In vegetable cultivation it is necessary to use protected ground both for seedling growing and for obtaining off-season vegetables. Lately vegetable growing branch is developing faster. Favorable soil and climatic conditions and increase in demand for vegetables are main reasons for expansion of production in researched branch. In Ukraine cucumber occupies 10–12 % of vegetables area. In protected ground its share reaches 70%. From research data one can see that area under cucumber in open ground is almost twice less in 2014 than it was in 2010. Also it is seen that gross harvest is 53.612 t less in 2014. However, yield in 2014 was 25.1 t/ha, that is 54.4 % more than yield in 2010. Area of closed ground was 0.67 ha larger, whereupon gross harvest and cucumber yield increased during the studied period. For a high harvest it is necessary to start with quality seedlings. Crops have to be same. This way harvest starts simultaneously, which is better both for

producers and for culture. When moved to a greenhouse seedlings receive much stress, so plant has to be very strong to overcome it. Considering worldwide demand for vegetable production, in particular for cucumber, and Ukraine capabilities of increase of gross vegetables production and decreasing of dependence on import, one can specify some of the main problems of this branch: implementation of new cultivars and hybrids of cucumber (of Institute for Vegetable and Water-Melon Cultivation of NASUA); usage of science-justified approach to crops cultivating, in particular growing zone specialization; development of innovational technologies of crops growing by means of adopting to specific soil and climatic farm conditions, cultivar and demands of client about finished products; information support, that is to consist of effective nationwide, regional and district advisory service, meteorological service with the involvement of lead specialists from scientific and educational institutions. One of the main directions of radical changes in economic situations in vegetables cultivation is improvement of usage of available household resources and bioclimatic potential of Kharkiv region by means of implementation of intensive resource-saving technologies.

Conclusion. Increase in vegetables production and increase of its economic effectiveness at this stage is possible only by virtue of innovational development of the branch. Nowadays innovational processes are crucial in successful, highly effective development of companies, regions and state. Their development has significant influence on economic and financial condition of companies and regions as well as on the living standards.

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THE GROWTH AND YIELDING ABILITY OF THE APPLE TREES OF THE INTRODUCED VARIETIES IN INTENSIVE ORCHARD

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Bibl. 14. P. 86–90.

Task assignment. The implantation of intensive apple orchards are making by using the varieties with high yield. They must have high demand on the market with high marketability of fruits and high taste [1]. High risk to make wrong choice is present during the implantation of the orchard due to the big range of varieties local and foreign breeding. It can fail realization of potential of the technology. Therefore learning of the varieties in current soil and climate conditions is important.

Researchresult. We have studied introduced apple varieties in the research orchard of Uman NUH. The Idared (control), Wilmuta, Golden Delicious clone B, Golden Delicious Reinders, Granny Smith, Jonaveld, Elshof, Mitchgla and Fuji were investigated in our research. The orchard was planted in 1995 by Dutch virus-free saplings with a crown. The rootstock is M 9 T337. Planting scheme is 4x1 m with shaping of the tree crown by spindle bush system. The system of inter-row spacing maintenance was sod and humus. The system of row spacing maintenance was herbicidal fallow land. The soil of research field is podzolizedchernozem heavy clay. Irrigation was done by using drip irrigation system.

The research was conducted according to the common methodic [11; 12]. Partition of varieties on groups for a yield and average weight of fruits were conducted according Kondratenko T. Ye. [13] and „Программа и методика сортоизучения плодовых, ягодных и орехоплодных культур” [12]. The received data were treated statistically by dispersive analysis.

It was found that the maximal total length of shoots had varieties Elshof and Fuji. Golden Delicious clone B and Idared showed the smallest total length of shoots. The varieties Elshof, Fuji and Golden Delicious Reinders were stand out for a number of shoots. They had 96 pcs per tree, 78 pcs per tree and 72 pcs per tree in accordance. The smallest number of shoots was fixed due to variety Idared (35 pcs per tree). Rest of varieties had from 42 to 56 shoots per tree at the same time. The highest number of shoots was observed in 2009 when yield was the smallest (table 1).

The average length of shoots was at 79 % higher than variety Idared due to the Elshof and it was at 67 % higher than variety Idared due to the Granny Smith and it was at 14 % less than variety Idared due to the Golden Delicious clone B. Rest of varieties had average length of shoots in a range from 26 to 32 cm what is consider as optimum for intensive orchards [14].

The trees of the variety Fuji were characterized by more branchy crown and higher vigor. It has an influence on the size of the crown (2,79 cubic meter). High parameters of crown size of the varieties Granny Smith, Elshof and Mitchgla were fixed. The smallest crown size had trees of the varieties Idared and Jonaveld. It was because of their weak vigor.

Table 1

Characteristics of the trees growth of the introduced apple varieties
on the M 9 rootstock at irrigation, average for 2005–2011

Variety, clone	Shoots			Crown size, cubicmeter
	total length, m	number, pcs/tree	average length, cm	
Idared (control)	6,90	35	22	1,10
Wilmuta	14,72	56	31	2,03
Golden Delicious clone B	6,88	42	19	1,32
Golden Delicious Reinders	17,42	72	28	1,86
Granny Smith	13,64	45	37	2,10
Jonaveld	9,57	44	26	1,14
Elshof	35,96	96	39	2,52
Mitchgla	13,61	48	31	2,19
Fuji	22,05	78	32	2,79
<i>LSD₀₅</i>	<i>4,62</i>	<i>13</i>	<i>5</i>	<i>0,49</i>

In spite of the active blossoming the sets of the trees were sluffing by a slight freezing of shoots tissue and base of the reproductive bud in 2006. It happened as a result of the high thermal discontinuity and changing of the thaw and frost periods during the winter.

The trees of the variety Mitchgla were characterized by the highest fruits number. It was because of reduction of average fruit weight. The average fruit weight of the varieties Wilmuta, Granny Smith and Jonaveld was from 145 g to 156 g. Those varieties had average fruit number per tree (table 2).

The small fruit weight had variety Golden Delicious clone B. At the same time variety Golden Delicious Reinders and Idared both had fruits of the same weight.

Average but stable yield was fixed due to the Mitchgla during the research years. The yield was higher than control at 45,9 %, 50,3 % and 40,5 % due to the varieties Wilmuta, Granny Smith and Fuji accordantly.

Low yield was observed due to the varieties Golden Delicious clone B and Elshof. It was because of low fruit weight of the first variety and small number of fruits per tree of the second variety.

The yield wasn't significantly higher than control due to the varieties Golden Delicious Reinders and Jonaveld.

High product yield of the superior and first market grades was differ Wilmuta and Granny Smith. At the same time Idared and Fuji had low product yield of the superior and first market grades. It may be due to the apple scab. The product yield of the superior and first market grades was significantly higher than control due to the variety Mitchgla because of higher number of fruits and their lower weight. For the rest of varieties the product yield of the superior and first market grades was from 71 % to 75 %.

Table 2

Productivity parameters of the trees of the introduced apple varieties
on the M 9 rootstock at heavy bearing age, average for 2005–2011

Variety, clone	Number of fruits, pcs/tree	Average fruit weight, g	Yield		Product yield of the superior and first market grade, %
			t/ha	% to control	
Idared (control)	49	135	15,8	–	66
Wilmuta	57	145	23,1	+ 45,9	79
Golden Delicious clone B	51	119	13,5	– 14,5	73
Golden Delicious Reinders	52	135	16,4	+ 3,5	73
Granny Smith	63	157	23,8	+ 50,3	81
Jonaveld	40	146	16,2	+ 2,6	71
Elshof	33	143	11,7	– 26,2	75
Mitchgla	78	116	20,6	+ 30,2	68
Fuji	62	131	22,2	+ 40,5	64
<i>LSD₀₅</i>	28	22	9,1	–	1

Conclusions. Thus research introduced apple varieties which characterized by moderate growth except the varieties Granny Smith and Elshof which had growth higher than optimal at 5,7 % and 11,4 % in accordance on the M 9 rootstock with irrigation.

Introduced apple varieties were separated to the groups compare to Idared. High yielding varieties are Wilmuta, Granny Smith and Fuji. Yielding variety is Mitchgla. Little yielding varieties are Golden Delicious Reinders and Jonaveld. Low yielding varieties are Golden Delicious clone B and Elshof.

The weight of fruit of Granny Smith was higher than average. The rest of varieties had average fruit weight. The variety Granny Smith had high product yield of the superior and first market grades. The Idared and Fuji had low product yield of the superior and first market grades.

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THE ELEMENTS OF TECHNOLOGICAL STUDY OF THE VARIETIES OF GARDEN STRAWBERRY (*FRAGARIA ANANASSA*)

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Bibl. 8. P. 91–95.*

Formulation of the issue. Due to the anatomical features of the formation of the fruit, the garden strawberry (*Fragaria ananassa*) belongs to low-lying cultures according to the classification of rich products by keeping capacity. It is possible to extend the consumption period of this delicious fruit, which also has medicinal properties, with the help of different ways of strawberry processing: preserving with sugar, thermal sterilization, freezing, drying.

Thanks to modern growing technologies nowadays we can enjoy fresh, fragrant, delicious fruits of the garden strawberry at any time of the year. But taking into account consumer's mental preferences and financial capabilities, there is always a demand for classical processed garden strawberries: preserves, stewed fruit, jam.

One of the components of the composite indicator if the strawberry fruits are suitable for technological processing for the above mentioned products are organoleptic (visual) properties of the raw product: appearance, taste, aroma, color.

Presenting the main material. In order to study the visual attractiveness of canned strawberries, after tasting fresh fruit the five varieties of garden strawberry were selected,

namely: Tenira (k), Ruby pendant, Lyuchynska, Thuriga, Olvia for the test processing of fruits by sugar preserving (jam making). The tasting of fresh fruit (in the phase of consumer ripeness) and processed fruit (after 6-month ageing) was conducted in the laboratory conditions using closed method.

Such varieties as Lyuchynska, Thuriga, and Olvia received the highest rating of the fruit appearance – 5,0 points; the other fruit varieties got the lowest rating – 4,5 points. The results of the tasting show that firm consistency is characteristic for such fruit varieties as Tenira, Ruby pendant, and Lyuchynska, the fruits other varieties are of medium firm texture. The fruits of all varieties under study had juicy sour-sweet pulp with a pleasant mild strawberry flavor. The highest overall rating of taste was given to the fruits of Olvia variety – 5,0 points, the lowest points went to the control fruit variety, Ruby pendant, and Lyuchynska – 4,0 points. The fruits of Olvia variety received the highest overall rating – 5,0 points, whereas Ruby pendant control fruit variety got the lowest rating – 4,3 points.

Before the research processing the fruits of all the varieties were evaluated by the following criteria: weight and unidimensionality of fruits, color intensity, pulp consistency, the ease of stalk separation from the fruit. The fruits of all varieties met the main requirements: weight – at least 5 g; color – intense red; form – regular, without pronounced ribbing; consistency – firm and medium firm pulp.

It should be noted that all the varieties except the control one satisfied the requirement of mild or moderate separation of the fruit cup and stem. Fruits of the control varieties are characterized by a very difficult separation of the cup with the stem from the fruit, causing significant injury to the fruit tissues during the preparation of the material for recycling.

The highest rating of jam appearance went to such varieties as Ruby pendant, Lyuchynska, and Thuriga – 5,0 points (due to the high content of anthocyanins, jam was extremely attractive); jam made from the control variety and Olvia got the lowest evaluation – 4,0 points.

The highest rates of fruit suitability for making jam got such varieties as Lyuchynska, Thuriga – 4,8 points and Ruby pendant – 4,5 points. The overall assessment of fruit suitability for making jam of the rest of varieties was 4,0 points.

Conclusions. Personal consumer preferences are formed primarily under the influence of visual characteristics of any product. A complex consistent approach to the selection of raw materials with high organoleptic characteristics will enable fans to fully enjoy strawberry jam. Among the varieties of garden strawberry under analysis the varieties Ruby pendant, Lyuchynska and Thuriga are most suitable for superior quality jam manufacturing.

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COMMERCIAL AND BIOLOGICAL EVALUATION OF AUTUMN APPLE VARIETIES DEPENDING ON ROOTSTOCKS

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Bibl. 5. P. 95–98.

Raising a problem. The most valuable apple varieties for commercial growers must have big attractive and tasty fruits. Besides, such variety should have good growth habits and other features like weak vigor, high frost and disease resistance, good productivity and fruit storability, precocity.

New apple varieties have bigger amount of positive characteristics and should be tested in specific environmental conditions.

The aim of our researches – selection of more productive rootstock-variety combination for more efficient commercial apple production in condition of Western Forest-Steppe zone of Ukraine.

The apple varieties growth and development estimation been done in 13-year orchard, which were planted at 5 x 3 and 4 x 2 m spacing. In test we have included apple varieties Slava Peremozhstiam as a standard, Witos and Auksis, which were grafted on three clonal rootstocks 54-118, 62-396 and Don 70-456.

Research results. Results of our researches show that all varieties had different growth vigor, canopy size and productivity depending on rootstock. The smallest trees of all varieties were on 62–396 rootstock – 3,38–3,53 m. More vigorous and much bigger were trees on 54–118 rootstock – 4,05–4,9 m.

Different types of rootstocks had a significant influence on varieties productivity and fruit size. More productive in our test was Witos/62-396 combination with average productivity 21,28 t/ha. Slava Peremozhstiam and Auksis on 62-396 rootstock had higher productivity (15,23–16,2 t/ha) comparing to other tested rootstocks: 14,34–19,04 t/ha on 54 - 118 and 13,32–18,97 t/ha on Don 70-456. Biggest fruit weight was provided by

Witos on all rootstocks – 170-191 g. Good fruit size for all varieties provide rootstock 62-396 as well.

Table 1

Growth and productivity of 13- year old apple varieties depending on rootstocks

Variety	Root stock	Tree height, m	Canopy volume, m ³	Trunk diameter, cm	Average productivity, c/ha	Average fruit weight, g
Slava Peremozh tsiam (s)	54-118	4,87	8,90	24,3	143,4	127
	62-396	3,53	5,16	21,1	152,3	136
	Д70-456	3,76	5,27	22,5	133,2	130
Witos	54-118	4,05	9,23	22,3	190,4	170
	62-396	3,38	4,27	20,5	212,8	191
	Д70-456	3,65	4,99	21,3	189,7	174
Auksis	54-118	4,90	8,93	25,1	153,4	130
	62-396	3,40	4,34	20,8	162,0	152
	Д70-456	4,03	6,06	24,6	142,7	138

Conclusion. After results analysis we can conclude that in the same condition rootstocks has significant influence on varieties growth and productivity. Better productivity for all tested varieties provided dwarfing rootstock 62-396.

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PRODUCTIVITY OF HYBRIDS BROCCOLI CABBAGE IN THE WESTERN FOREST STEPPE ZONE OF UKRAINE

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Bibl. 9. P. 98–102.*

Statement of a problem. Broccoli cabbage widely cultivated in the United States, Canada, Japan, Britain and Western Europe. In Poland, the areas under this crop occupy more

than 7 th. ha, while in Ukraine only about 1500 ha (3 % of the cabbage vegetables).

Broccoli is different from other types of cabbage high content of nutrients, a special taste and a high biological activity, so it is quite a valuable dietary product, especially for baby food.

Today in the world is known about 200 varieties and hybrids of broccoli. In the State Register of plant varieties which are suitable for dissemination in Ukraine, there are no varieties and hybrids of domestic breeding. Varieties and hybrids that are adapted to specific soil and climatic conditions and resistant to most common diseases are basis of high, and most environmentally safe of harvest.

Analysis of recent research and publications. The basic requirements that put manufacturers to modern varieties and hybrids of broccoli for industrial production are: high yield, tight head (inflorescence), high quality and keeping quality buds, fitness for fresh market and processing, ductility and resistance to stress, plants with strong root system and the dominance of the central stem, resistant to disease and escalation.

Improving the varietal of resources is important condition for increasing the productivity of vegetables, improve product quality by increasing the content of nutrients and minimal accumulation of toxins.

Growth yields and gross harvests of broccoli depend on many factors, among which an important place belongs to the assortment selection. Therefore, in view of improvement of technology of growing and obtaining environmentally safe products of broccoli in Western Forest Steppe zone of Ukraine actual importance is the selection of new hybrids of broccoli tailored to specific soil and climatic conditions.

Formulation of the problem. The main task of our research was to study the yield, quality, resistance to disease of broccoli hybrids of foreign selection in conditions of Western Forest Steppe zone of Ukraine.

The main material. Research was conducted during 2013–2015 years on experimental field of Department of Horticulture and Vegetable on dark-gray podzolized lightweight-loam soils.

Studies have been conducted to study of hybrids broccoli of foreign selection: Laki F₁ (Bejo zaden – control); Batavia F₁ (Bejo zaden); Belstar F₁ (Bejo zaden); Monaco F₁ (Syngenta); Rumba F₁ (Clause); Halimark F₁ (Bejo zaden).

Growing of broccoli cabbage was conducted of seedling method. Seeds sown in early April in the cold hotbed, seedlings were planted in the third decade of May by the scheme 70 × 35 cm (40 thousand. pcs./ha). Preceded – potatoes. In the autumn under autumn plowing applied 40 t/ha of organic fertilizer, in the spring under cultivation of fertilizers (nitroamophoska – 16–17 kg. active substance) at norm N₆₀R₆₀K₆₀. Counted yield and determined the quality indicators of yield and biochemical composition.

Research has established, that lowest yield received by growing of hybrid Laki F₁ (control) – 21,7 t/ha. The highest yield commodity of heads provides of hybrid Monaco F₁ (41,5 t/ha). Marketability of yield depending on the hybrid ranged from 87% (Laki F₁) to 97% (Monaco F₁).

Research has established that all hybrids of broccoli have high quality product, particularly the best quality indicators of commodity products provide hybrids of foreign selection – Monaco F₁, Rumba F₁, and Belstar F₁, which marked a high dry matter content

(12,0; 11,4; 11,2 %), the amount of sugar (2,9; 2,7; 2,6%), vitamin C (118,5; 99,6; 92,0 mg/100 g), protein (3,2; 3,0; 2,9 %).

The nitrate content in the study hybrids did not exceed the the maximum permissible concentration and ranged from 252 (Rumba F₁) to 290 mg/kg (Halimark F₁). The most resistant to damage such diseases as: *Alternaria solani* (1 point) *Peronosporium* (2 points) and *Pectobacterium carotovorum* subsp.*carotovorum* (1 point) were hybrids – Monaco F₁, Rumba F₁, Belstar F₁.

Conclusions. In conditions of the Western Forest Steppe Zone of Ukraine high yield of broccoli cabbage with good quality products was received by growing of hybrids foreign selection – Manok F₁, Rumba F₁ and Belstar F₁.

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INFLUENCE FOLIAR FEEDING OF FERTILIZERS OMEX ON PRODUCTIVITY OF CELERY ROOT IN THE CONDITIONS PRYKARPATTIA OF UKRAINE

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Bibl. 5. P. 103–106.

Statement of a problem. The system of fertilizer is an important factor in increasing the crop yield and quality of vegetables. One way to optimize the mineral nutrition of vegetables, including celery root is a foliar feeding, which compensates for the deficit

essential elements of plant nutrition, especially in adverse conditions, where mineral nutrients are in the sufficient quantities in the soil, but the insufficient number moisture during the growing season, low temperature, increased acidity of soil nutrients are not assimilated fully with soil. Therefore the use of modern water-soluble fertilizer in the form of emulsions for foliar feeding celery root is an important factor of receipt high yield.

Analysis of recent research and publications. Celery root is a valuable spice gustatory of rare plants. Productivity of celery can be provided by many factors, including foliar feeding system, especially during intense crop formation (July–August). Big role here belongs to macro- and micronutrients, which in this period increased need.

With the improvement of technology of cultivation of celery root in conditions of Prykarpattya Ukraine actual importance to study the effectiveness foliar feeding different types of fertilizers OMEX.

Formulation of the problem. The aim of the study was to establish effectiveness of different types of foliar feeding of fertilizer Omex on productivity and quality of celery root.

The main material. Research was conducted during 2013–2015 years in conditions of Prykarpattya Ukraine on the farm "Meleshko" Mykolayiv district, Lviv region. The soil of experimental plots – sod-podzolic, medium-loam.

The subject of the research was the Dutch sort of celery root Diamond. The scheme of the experiment included such variants:

1) Without fertilizer (control); 2) $N_{90}P_{90}K_{90}$ – Von; 3) Von + Omex 3x; 4) Von + Omex MikroMaks; 5) Von + Omex Sikvential 2; 6) Von + Omex Foliar Boron; 7) Von + (Omex 3x + Omex MikroMaks + Omex Foliar Boron); 8) Von + (Omex MikroMaks + Omex Sikvential 2 + Omex Foliar Boron); 9) Von + (Omex 3x + Omex MikroMaks + Omex Foliar Boron) + (Omex MikroMaks + Omex Sikvential 2 + Omex Foliar Boron). Mineral fertilizers apply at norm: Omex 3x – 2 l/ha; Omex Foliar Boron – 1 l/ha; Omex MikroMaks – 1 l/ha; Omex Sikvential 2 – 2 l/ha.

The first foliar feeding different types of fertilizers OMEX performed in the phase of the growth of roots in the III decade of July. On the 9 variant following the first foliar feeding (Omex 3x + Omex MikroMaks + Omex Foliar Boron) after 15 days apply second foliar feeding (Omex MikroMaks + Omex Sikvential 2 + Omex Foliar Boron).

The seedling were grown in film greenhouses with heated. Age of seedlings is 60 – 70 days. The seedlings was planted in early first decade of May. Growing scheme of seedling 70×25 cm. As the main fertilizer apply mineral fertilizer nitroamofos of brand 16:16:16 at norm $N_{90}P_{90}K_{90}$ (Von) during spring cultivation. In autumn, after cleaning predecessor (winter wheat) during autumn plowing apply $CaCO_3$ at normal 6 t/ha by hydrolytic acidity.

Research has established that foliar feeding different types of fertilizers Omex, separately or in tank mixtures has positive effect on productivity and marketability celery root. On the average for three years of research highest yield 40,3 t/ha of celery root received on 9 variant at complex (tank mixture) foliar feeding of Omex in two stages.

Foliar feeding of Omex, both separately and together they applying had a positive effect on the biochemical composition of roots of celery. Thus, highest quality of products have received on 8 variant by foliar feeding Omex MikroMaks + Omex Sikvential 2 + Omex Foliar Boron. This variant marked the lowest content of nitrate nitrogen – 122 mg / kg wet

weight. Established, that high quality products of celery root also received on 7 and 9 variants of experiment.

Conclusions. Research has established, that in the conditions Prykarpattya of Ukraine high yield and quality of celery root received by applying foliar feeding in two terms of different fertilizers Omex In the tank mixtures.

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CHAPTER 5 SELECTION

FIELD RESISTANCE OF POTATO HYBRIDS TO LATE BLIGHT, DEPENDING ON COMBINATION OF PARENT COMPONENTS

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Problem setting. Late blight is one of the most spread diseases of potato. Problem of potato protection against late blight by means of selection and introduction of competitive sorts into production is of special attention in the western region of Ukraine, which is located in a zone of maximal effect of pathogenic agent.

Assessment of crossing combinations and hybrids seedlings as to resistance to late blight, depending on combination of parent components helps determining of better forms for practical selection on that characteristic.

Analysis of the latest researches and publications. Leading scientists consider that selection of disease-resistant sorts is the principal way to fight late blight.

In selection of potato sorts, resistant to late blight, correct choice of pairs for crossing is of principal importance.

Task setting. Task of our research is to study resistance of potato hybrids to late blight, depending on combination of parent components in order to select expected forms for practical selection.

Main material. Experiments were carried on the fields of educational-scientific center of Lviv NAU. Soil of the experimental field was dark-grey podzolic light loamy one. We used agricultural machinery, common for the zone. Mineral fertilizers were applied in norm $N_{90}P_{90}K_{120}$.

We studied resistance of hybrids of the first vegetative reproduction to late blight, depending on a choice of parent pairs.

Potato sorts of different ecological-geographic groups were taken as parent material for crossing. Karpatska, Mavka, Slava, Luhovska, Polonyna, Zarevo, Sozh, Granola were selected in scientific-research institutions of Ukraine, Byelorussia and Germany.

Karpatska. The sort is late-season, universal, with high content of starch. Cancer-resistant. High field resistance to late blight features the sort, genotype $R_1R_2R_4$.

Bush is high, erect, stems are sick, with few branches. Leaves are mid-cut, large. Flowers are white. Bulbs are large, red and round-oval. Pulp is white, does not get dark while boiling, tastes good. The sort is good for crossing as parent and female parent forms.

Polonyna. Late-season. Eating sort. The sort is moderately infected by late blight.

Mavka. Mid-season. Universal sort, with high tasty qualities (4,3–4,4), demonstrating high resistance to late blight.

Slava. Mid-season, high yielding, eating sort, resistant to cancer, late blight and virus diseases. Potential yield capacity makes 650 c/ha. Starch content in bulbs makes 13,1–15,8 %.

Luhovska. Mid-season, eating sort. Taste characteristics make 4,0–4,2 grade. The sort is characterized with high field resistance to late blight and the most spread virus diseases.

Zarevo. Mid-season, universal sort, characterized with high field resistance to late blight.

Sozh. Late-season, eating sort. High yielding, mid-season. The sort is resistant to cancer and potato cyst nematode of late blight.

Granola. Nematode-resistant. Resistant to potato blight, potato scab, viruses, mechanical damages, but is not resistant to cancer.

In the group of crossing combinations, where Zarevo sort was used as parent form, descendants of combinations Karpatska x Zarevo, Mavka x Zarevo were the least infected by late blight. The average grade of resistance of those combinations made $8,2 \pm 0,1$ and $8,9 \pm 0,1$, and number of high-resistant hybrids in the extreme plus – class made 43,5 % and 38,0 %

In the second group of combinations with Sozh sort, hybrid descendants, obtained from combination Karpatska x Sozh, demonstrated the best results. The average grade of resistance to late blight made $8,1 \pm 0,1$, and the share of blight-resistant hybrids made 36,9.

In the group of crossings, where Granola sort was applied as parent form, resistance of crops to late blight fluctuated between $6,9 \pm 0,2$ (Mavka x Granola) and 7,9 (Luhovska x Granola).

Conclusions. Resistance of hybrids to late blight depends on combination of parent components. The most resistant hybrids were obtained from combinations of crossings of Karpatska x Zarevo, Mavka x Zarevo, and Karpatska x Sozh.

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RESULTS OF EVALUATION OF PROMISING HYBRID OF POTATOES IN A COMPETITIVE AND DYNAMIC STRAIN TESTING

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Bibl. 10. P. 112–117.

The formulation of the problem. Over the next 30 years, the world will need to increase the volume of food production by 60 % to feed a world population that is projected to scientists in 2050 may reach 10 billion people. And potato will continue to be crucial to address the food. No accident that culture is the fourth in the world among food agricultural crop after maize, wheat and rice. Therefore, the raising its crop capacity, total fees and quality parameters of tubers remains an urgent task. Along with other factors intensify of the potato, the most efficient and effective is breeding and implementation of new potato varieties with high potential productivity, quality of yield and combined resistance to disease and stress environmental factors in practice.

The main material. Breeders of LNAU created a number of hybrids of potatoes which different by origin and biological maturity. In 2012 – 2015 years, 28 newly created hybrids were passing breeding elaboration on the final stage of selection – competitive strain testing. The objective was to give a comprehensive assessment of hybrids for agronomic characteristics and select the best form for further breeding and pre-breeding.

The each hybrid and appropriate varieties-standards of potatoes planted with an area of plant nutrition 70 x 35 cm. The standard for medium early group was sort "Vodograj", middle – "Volya" and medium late – "Zaxidna".

Analysis of the parameters of the final crop capacity and content of starch in tubers of potato hybrids showed that according to absolute values they, in some forms, are significantly higher than indices of the varieties-standards. In a group of medium early forms with high crop capacity notes H.02/11-8 (Borodyanka rozheva x Tempora) – the average for 2013 – 2015years it reached 397 c/ha, in hybrid 11/7.17 [(Zaxidna x (Student x Sante))] – 396 c/ha to 365 c/ha in a variety-standard. The medium-early hybrid 11/15-12 [(Zaxidna x (x Borodyanka rozheva x Oksamyt))] successfully combines the high crop capacity (390 c/ha) and high content of starch in tubers – 18.3 % against 14.1 %.

In the middle group were selected promising form of hybrids with a potential crop capacity of tubers over 40 t/ha. In particular, the hybrid 02/2-17 (Volya x Lishhyna) – 418 c/ha and H.11/2-2 [(Svitanok kyyivskyj x Pamir) x (Zaxidna x Povin)] – 414 c/ha to 373 c/ha in a variety-standard. In the group of middle-late forms we selected the promising hybrid 11/2-26 [(Svitanok kyyivskyj x Pamir) x (Zaxidna x Povin)] with a potential crop capacity of tubers over 50 t/ha – 510 c/ha, which is 204 c/ha more than crop capacity of a variety-standard. The content of starch in tubers of hybrid is quite high – 19.0%, or 4.2% more than the standard of Zaxidna. The high crop capacity potential has also been in a hybrid 99/11-4 (Student x Sante) – 448 c/ha, 142 c/ha more than in the standard.

In the system of protection of potato from late blight epiphytoties the important value have growing varieties which are characterized by high or increased resistance to

phytophthora fungus. The research has found that the number of studied potato hybrids of different groups of ripeness combines in one genotype a high performance, high starch content in tubers with increased and high resistance tops against late blight of 7 - 8 points on a 9-point of the international scale.

The group of middle-early forms include hybrids 02/11-96 (Borodyanka rozheva x Tempora) and 99/9-13 (Student x Prolisok). In the group of middle forms a high resistance to late blight of aboveground mass showed hybrids of 02/12-18 (Borodyanka rozheva x Oksamyt), 02/2-17 (Volya x Lishhyna), 02/14-28 (Borodyanka rozheva x Prolisok), 11/2-29 [(Svitanok kyuyivskyy x Pamir) x (Zaxidna x Povin)]. The promising in potato breeding for resistance to phytophthora are medium-late hybrids 99/11-4 (Student x Sante), 11/6-15 (Volya x H.374-66), Volya x H.374-66 [(Svitanok kyuyivskyy x Pamir) x (Zaxidna x Povin)] and others.

Conclusions. Educational Research Institute of breeding and technology of LNAU in recent years has created a number of promising hybrids of potatoes that are had complex of biological and economic characteristics. The immune system of new hybrids to the most harmful diseases of potato gives possibility to limited use pesticides, allowing get for environmentally friendly products and promotes to protection of agrobiocenosis. Selected promising hybrids of potato will take further breeding elaboration in accordance with the scheme and the method of selection of the culture, and the best of them – the previous breeding season.

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THE YIELD POTATO VARIETIES OF DIFFERENT MATURITY GROUPS IN THE DYNAMIC TEST

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Bibl. 6. P. 117–121.

Formulation of the problem. The use a potato varieties with biological features that the most corresponding to climatic zone of cultivation is an important factor in improving and stabilizing yields.

To study the productivity of 30 potato varieties of different maturity groups listed in the Register of Plant Varieties of Ukraine in conditions of Southern Polissya and Western Small Polissya of Ukraine on purpose to use the potential of the variety and provide the necessary assortment for needs of consumers.

The main material. Significant increase of yield is provided at cultivation of high-productivity potato varieties. Intensive use of varieties (especially new) that are more resistant to the most common and harmful potato diseases is an important factor in the stabilization of potato growing in Ukraine.

The concentration of potato production on small plots almost under monoculture promotes to rapid infection by viral, mycoplasmal, fungal and bacterial diseases and nematodes. These all lead to a sharp decrease in productivity of potato. Replacement of varieties largely decides the problem of using in the production of quality seed.

During 2011 – 2015 in Institute of Potato of NAAS of Ukraine in conditions of southern Polissya and LLC "Scientific-Production Enterprise "Bulba" Kamyanka-Buzka district Lviv region, which is a branch of the Chair of Genetics, Selection and Plant Protection of Lviv National Agrarian University in Western small Polissya studied the numerous of registered potato varieties different maturity and economical purpose (early varieties: Povin, Zheran, Zagadka, Karlyk04, Kimeriya, Melody, Serpanok, Skarbnytsya, Tyras; medium-early: Svitanok Kyivskiyi, Dara, Zabava, Zaviya, Lishchyna, Levada, Oberig, Fantasiya; middle-maturity: Slovyanka, Bylyna, Volya, Zahidna, Zvizdal, Dovira, Lileya, Nadiyna, Yavir, middle-late: Olviya, Dorogyn, Poliske Dzherelo, Chervona Ruta), concerning their productivity in different periods of vegetation.

The technology of potato cultivation in experiment was common for areas of Polissya. Predecessor – winter wheat. Soil tillage, fertilization, planting and care of crops conducted in optimal terms. The experiment carried out using common methods. Area of each plot was 25 m², four-place repeated.

Yield dynamics was determined at testing digging of two bushes of each variety in four plots. First digging carried out in all the years of research the 1st of July, the next – every ten days. In average on five years testing (2011 – 2015) on 60–65 days after planting the highest yield was in early varieties: Kimeriya, Povin, Tyras (141–146 c/ha) and middle-early varieties Lishchyna, Oberig (125–129 c/ha). These early varieties on 80 - 85 days was forming yield within 228–250 c/ha, middle-early Fantasiya, Lishchyna and Oberig – 207–229 c/ha.

The highest yield at dying vegetative mass (in the second decade of August) is determined for the early varieties Povin (276 c/ha) and Skarbnytsya (270 c/ha), for medium-early varieties Oberig (265 c/ha), Fantasiya (258 c/ha) and Lishchyna (270 c/ha). In the group of middle-maturity varieties as among all tested varieties, the highest yield in the third decade of August was determined for variety Slovyanka (298 c/ha) and Volya (299 c/ha). In the group of middle-late varieties the highest yield was detected for varieties Olviya (270 c/ha) and Chervona Ruta (277 c/ha).

Conclusions. At the high temperatures of air and soil during the growing season and much less rainfall in May and insufficient amount of them in July at the first digging high yield was only in a few varieties: early – Tyras (145–269 c/ha), Povin (146–276 c/ha) Kimeriya (141–269 c/ha) and medium-early – Oberig (129–265 c/ha) and Lishchyna (125–270 c/ha). Under such conditions at the end of vegetation period the highest yield was determined for the early varieties Skarbnytsya (289 c/ha), Povin (287 c/ha) Kimeriya (287 c/ha) and Tyras (284 c/ha), medium-early Lishchyna (293 c/ha), middle-maturity Slovyanka (316 c/ha), Volya (318 c/ha) and Yavir (315 c/ha), middle-late Olviya (303 c/ha) and Chervona Ruta (304 c/ha).

However, it should be noted that productivity of different maturity varieties is largely depend on weather conditions in the year of cultivation.

Perspectives. In seed production advisable to focus on growing seed of varieties that give stable yields in the region and to ensure consumer potatoes in the needed assortment.

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CRITERIA OF PRODUCTIVITY OF POTATO SEEDLINGS, SELECTED WITH PARTICIPATION OF KARPATSKYI VARIETY IN GENEALOGICAL COMPLEX

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Bibl. 14. P. 122–156.*

Problem setting. We have made experimental researches, connected with the problem of selection of competitive potato varieties of different use, taking some other basic material, for several decades of years. It is connected with the theoretical study of biological fundamentals of plants in the Western region of Ukraine with application of genealogical complex of Karpatskyi variety.

Main material. In 2013 – 2015, potato seedlings were examined in seed-plot of competitive testing, on the fields of the Department of Technologies in Crop Production of the Educational-scientific-research center of Lviv National Agrarian University on dark-grey podzolic light loamy soil. The seedlings were selected with the use of the existing variety of genetic pool, having the defined biological peculiarities, particularly the varieties, selected under genealogical complex with participation of Karpatskyi variety, which is the well-known “donor” in the history of selection. Multiple combinations, used to achieve the expected results, included such varieties as Granola, Naroch, Karpatskyi and the varieties, selected on its base, i.e. Mavka and Polonyna. Variety Svaliavska was taken as a reference standard.

Under the genealogical complex of Karpatskyi variety in crossing combinations of varieties Mavka x Granola, Polonyna x Granola, Mavka x Naroch, Polonyna x Granola we selected economically valuable seedlings 369-93, 511-93, 322-92, 376-92 and seedling 7-1-08 (self-pollination of Karpatskyi variety) in seed-plots of the selection process. Having analyzed data of the three-year competitive testing, the chosen seedlings deserve particular consideration as to their reproduction. In particular, seedling 511-93 demonstrated the best competitive capacity according to economic estimation criterion. It was selected by combination of varieties Polonyna x Granola. In 2013 – 2015, the average yield capacity of the seedling made 40,5 t/ha, that is by 11,2 t/ha more than Karpatskyi variety and by 14,2 t/ha more than the reference standard, i.e. Svaliavska variety. Seedling 511-93 is middle-ripe, food-factory use with good culinary and tasty characteristics (8,5 grade). Tubers are round-shaped, white, with smooth peel, shallow eyes and white pulp. The average weight of a tuber makes up to 76 g. A share of starch in tubers makes 19,6 %, that is by 5,8 % more than in Svaliavska variety. It is high resistant to late blight (8,5 grade) and other diseases.

Seedling 322-92 is selected by the combination of varieties Mavka x Naroch. In 2013 – 2015, the average yield capacity of seedling tubers made 35,8 t/ha, that is by 6,5 t/ha more than Karpatskyi variety and by 9,6 t/ha more than the reference standard, i.e. Svaliavska variety.

Seedling 322-93 is middle-ripe, food-factory use with good culinary tasty characteristics of tubers (8,8 grade). Tubers are round-shaped, white, with smooth peel, shallow eyes and white pulp. The average weight of a tuber makes 88 g. A starch share in tubers makes 18,8 % that is by 4,7 % more than in Svaliavska variety. It is high resistant to late blight (8,8 grade) and other diseases.

According to economic estimation (high yield capacity, quality of tubers, and crop resistance to diseases) seedlings 511-93 and 322-92 correspond to the criteria of recognition and submitting for testing by the State office on protection of rights for plant varieties.

Conclusions. The research proves efficiency of Karpatskyi variety in selection of potato varieties. Use of it, in genealogical complex, resulted in selection of varieties, which take leading positions among those, listed in the Catalogue of varieties, suitable for cultivation in Ukraine. Seedlings 369-93, 511-93 and 322-92, selected by crossing combinations of varieties Mavka x Granola, Polonyna x Granola, Mavka x Naroch and seedling 7-1-08, obtained from self-pollination of Karpatskyi variety, make theoretical interest and practical value.

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CHAPTER 6 PLANT PROTECTION

THE CROPS PROTECTION OF WINTER RAPE AGAINST DISEASES

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Bibl. 8. P. 127–132.*

Rising of problem. During the last years in Ukraine big attention is given technical oilseeds such as rapeseed oil which is used in many sectors of the economy. Direction using of rapeseed oil as an alternative fuel source of energy it is rapidly developing. Unconditional value of biodiesel and oils obtained from rapeseed oil is their environmental friendliness, such as those microorganisms are neutralized within 7 - 8 days [1; 3; 4; 5]. Perspective is the use of rapeseed oil in the production of non-toxic lacquers, paints, solvents. Manufacturers of synthetic detergents used oil from rapeseed in washing powders, soaps, emulsifiers, and foam and antifoam substances. Rapeseed oil and is used as a material for chemical synthesis. Rape straw used to make paper, energy briquettes [2; 5; 7].

Analysis of the last researches and publications. Great damage to crops of winter rape causing disease pathogens is able to cause significant yield losses and lower quality products. The most dangerous are those that development on plants during the growing period [4; 6; 8].

Rising of task. Effective protection of plants of winter rape against pathogen diseases provides the use of fungicides. The aim of research was to study the effect of spraying new fungicides on the extent of diseases development and to determine the technical and economic efficacy of fungicides.

Exposition of basic material. Experiments were laying on winter rape hybrid Hercules. We studied the efficacy of fungicide Caramba Turbo, 24 % s.c. for winter rape plants spraying autumn and fungicide Caramba Turbo, 24 % s.c. and Alterno, 21 % e.c. in the spring. During flowering used fungicides Alterno, 21 % e.c. and Pictor, 40 % s.c. (Table 1).

The first symptoms of disease phoma rot and downy mildew on plants of winter rape in autumn we observed in the phase formation rosette of leaves. The first symptoms of disease of alternaria spot, powdery mildew and sclerotinia rot observed in the spring. In the phase of intensive plant growth development alternaria spot was in 2014 – 5.7 % and in 2015 – 4.5 %, powdery mildew – 5.4 and 10.5 %, sclerotinia rot – 1.2 and 1.0 %, respectively. The highest development of alternaria spot 9.6 % was in 2014, powdery mildew 15.0 % in 2015 during plants early flowering. Intensive increases of plant disease were observed during the formation of pods. Symptoms of diseases were found not only leaves and on stems and pods. During the forming pods development of alternaria spot

was the highest 22.4 % in 2014 and in 2015 was the highest development of powdery mildew 22.4 % and alternaria spot 20 % (Figure 1).

Table 1

The scheme of fungicides application

№ variant experiment	I spraying (in phase of 4-6 rape true leaves) BBCH 14-16	II spraying (at height 20–25 cm plant) BBCH 31-53	III spraying (flowering) BBCH 61-65
1	Control (plant application of water)	(plant application of water)	(plant application of water)
2	Caramba Turbo, 24 % s.c. – 0,7 l/ha	Caramba Turbo, 24 % s.c. – 0,7 l/ha	Pictor, 40 % s.c. – 0,5 l/ha
3	Caramba Turbo, 24 % s.c. – 0,7 l/ha	Alterno, 21 % e.c. – 0,7 l/ha	Pictor, 40 % s.c. – 0,5 l/ha
4	Caramba Turbo, 24 % s.c. – 0,7 l/ha	Alterno, 21 % e.c. – 0,7 l/ha	Alterno, 21 % e.c. – 0,7 l/ha
5	Caramba Turbo, 24 % s.c. – 0,7 l/ha	Caramba Turbo, 24 % s.c. – 0,7 l/ha	Alterno, 21 % e.c. – 0,7 l/ha

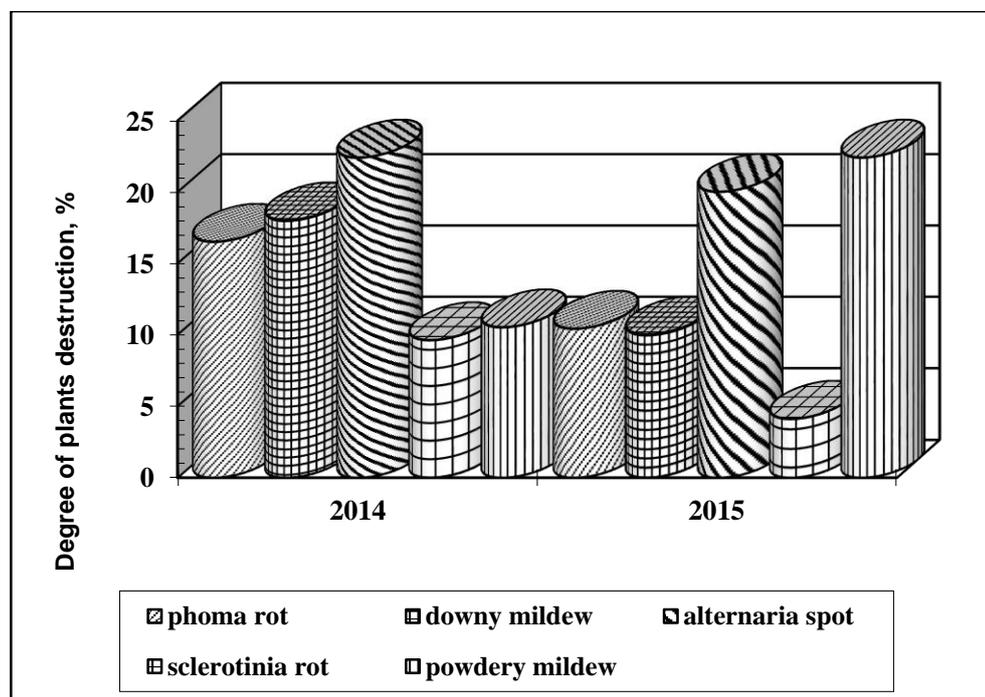


Fig. 1. The degree of destruction of winter rape by major pathogen diseases, 2014 – 2015 years. (Control – without the use of fungicides).

Figure 2 shows the degree development of rape disease on variants of the experiment. Autumn application of fungicide Caramba Turbo, 24 % s.c. and spring spraying Alterno, 21 % e.c., and the use in during flowering Pictor, 40 % s.c. provided a low degree of destruction plants. Thus, the development of phoma rot this variant was 3.0 %, downy mildew 2.1 %, alternaria spot 4.4 %, powdery mildew 2.4 % and sclerotinia rot 1.4 %. The development of disease in the variant using fungicide Caramba Turbo, 24 % s.c. autumn and Alterno, 21 % e.c. spring and during flowering Alterno, 21 % e.c. was also very low respectively 3.2, 2.2, 4.5, 2.8 and 2.0 %. The development of diseases in variants experiment, where the first spraying autumn and second spraying spring used Caramba Turbo, 24 % s.c., and for the third spraying flowering period Pictor, 40 % s.c. or Alterno, 21 % e.c. was higher.

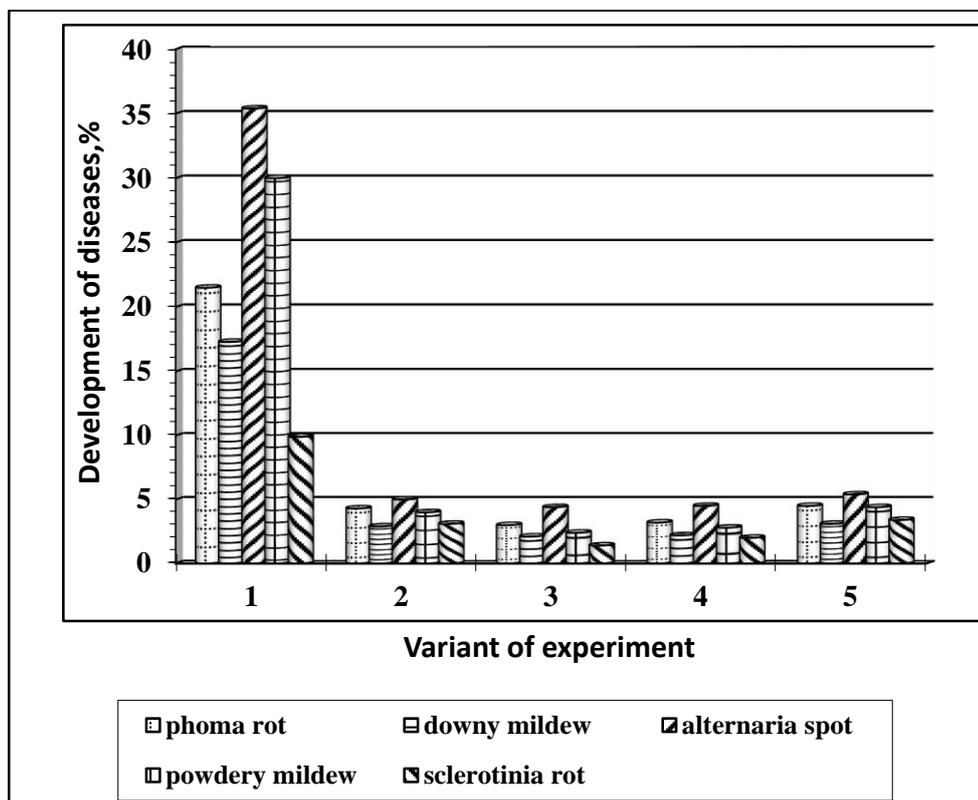


Fig. 2. The development of major winter rape diseases on variants of experiment, 2014 – 2015 years.

The highest fungicide technical efficiency ensured a third variant of the experiment. Thus, the technical efficiency of system sequential fungicide application Caramba Turbo, 24 % s.c. + Alterno, 21 % e.c. + Pictor, 40 % s.c. was 87.9 %. Slightly

lower technical efficiency 86.0 % obtained in the fourth variant, by the sequential use of fungicides Caramba Turbo, 24 % s.c. + Alterno, 21 % e.c. + Alterno, 21 % e.c. (Fig. 3).

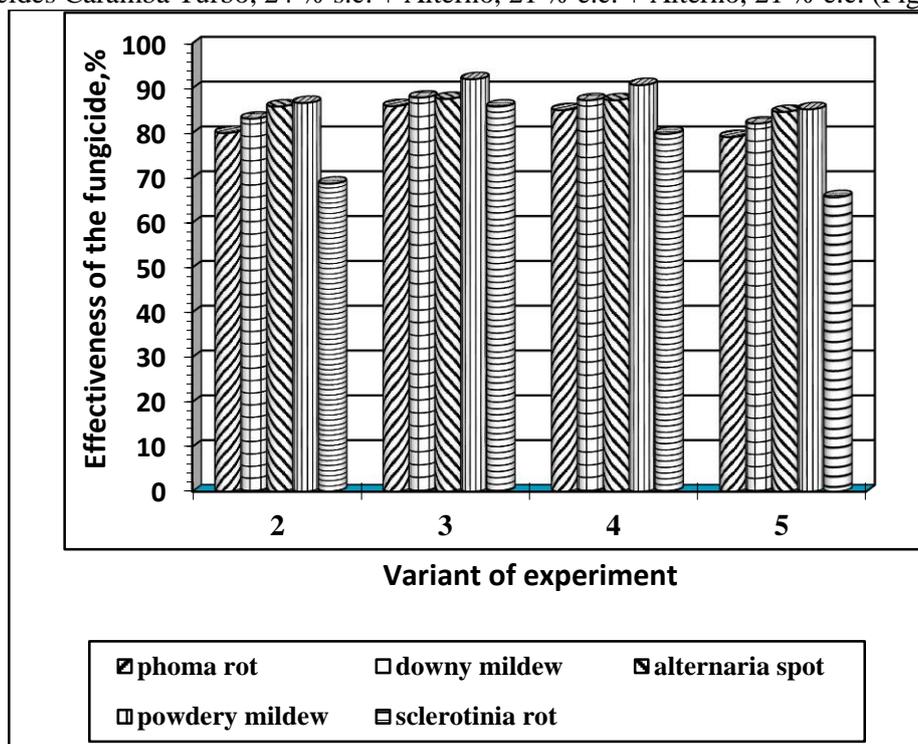


Fig. 3. Technical efficiency schemes making fungicide against pathogens of major diseases of winter rapeseed 2014 – 2015 years.

Economic efficiency of winter rapeseed system plants protection against pathogens diseases on variants experiment presented in Table 2. The highest yield – 44.5 c/ha provided a third variant of the experiment, what was 17 c/ha yield in addition to control. High yield – 44.0 c/ha provided also a fourth variant, what amounted to 16.5 c/ha to control. Between these two variants of the actual difference in value of yield and weight of 1000 seeds did not extend beyond limit the least significant difference that was not substantially.

In the second and fifth variants of the experiment were received substantially lower yield, respectively, 41.7 and 41.3 c/ha, but amounted to 14.2 and 13.8 c/ha in addition to the control. Increased yield hybrid Hercules for the use of fungicides provide better indexes yield structure, including higher levels of mass 1000 seeds compared to control.

Conclusions. To protect winter rape plants against major diseases suggested to use a system what include the first spraying in the phase of 4-6 true leaves fungicide Caramba Turbo, 24 % s.c. – 0.7 l/ha, the second spring spraying at plant height 20–25 cm fungicide Alterno, 21 % e.c. – 0,7 l/ha and the third spraying in phase full flowering fungicides Pictor, 40 % s.c. – 0,5 l/ha or Alterno, 21 % e.c. – 0,7 l/ha. The use of the proposed

schemes making fungicide protects plants against attack by pathogens alternaria spot, powdery mildew, phoma rot, downy mildew and sclerotinia rot and provides high technical and economic efficacy.

Table 2

The economic efficiency of different schemes for making fungicides

Variant of experiment	Mass 1000 seeds, g	Yield, c/ha			± to control
		2014	2015	average	ц/га
1	3,8	30,1	24,8	27,5	-
2	4,5	43,3	40,0	41,7	14,2
3	4,8	45,8	43,1	44,5	17,0
4	4,7	45,1	42,8	44,0	16,5
5	4,4	42,8	39,8	41,3	13,8
HIP ₀₅	0,31	1,78	2,08		

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INFLUENCE OF VARIETIES FEATURES AND FUNGICIDES TREATMENT ON DEVELOPMENT OF MAIN FUNGAL DISEASES OF POTATO

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Bibl. 5. P. 132–136.

Problem statement. Fungal diseases affect potato in vegetative period and in storage. Significant losses cause pathogens that infect vegetative mass and decrease assimilation surface thus reduce indexes of productivity of culture. For today achieve high yield of potato unfortunately is impossible without chemical method that provide preventive and therapeutic effect in lesions by pathogens. Don't forget about significance of variety as significant factor in integrated plant protection. For potato varieties that fewer lesions by any pathogen need lower frequencies of fungicide treatment. It's very important to environment.

Analysis of recent publications. Potato stays one of few crops planting area of which have not significantly changed in Ukraine. It's one of main crops, it's cultivated in all soil-climatic zones [5]. The losses of potato yield from diseases every years are 30 – 35 % in average, in epiphytotic years – 50 % and more [2].

Late blight was and still is wide-spread disease in humid conditions. It causes rapid dying of foliage in favorable conditions for its development. Harmfulness of disease is in decrease of yield as result of reduce of assimilation surface and lesion of tubers that rapid rot at storage.

Now it occurs tendency to global warming leading to rapidly increase early blight [3]. It raises concern of specialists and researchers from different countries. Disease occurs in beginning of potato vegetation and develops during summer especially in dry warm weather. The lesion of plant by early blight cause direct losses of yield which manifested crop shortfall and formation small non-standard tubers that reduce marketability of products [4]. From infected tissues of potato plants researchers isolate other fungi: *Ascochyta lycopersici* (Plover) Brun., *Cladosporium herbarum* Link, *Colletotrichum phomoides* (Sacc.) Chest., *Phoma* sp. They don't cause typical symptoms and isolated together with *Alternaria* fungi [1].

Task statement. The aim of research was determine the influence of potato varieties features on development of late blight and early blight and detect the best protection systems of potato in conditions of "Agrarian Company "Proskuriv" in Khmelnytsky region.

Results. During 2013 – 2015 studied effectiveness of fungicides for protection from main fungal diseases (table 1) on three potato varieties that cultivated in farm: Podolyanka, Serpanok and Skarbnitsya.

Late blight and early blight have observed on all varieties during three years of research. Their increase was gradually and obtained maximum on end of vegetation (fig.). Comparing the development of late blight and early blight on potato varieties may be noted they infected by diseases in different degrees. Studying of development dynamic

these diseases on investigated varieties detected that more infected by late blight on end of vegetation was variety Serpanok. On control variant of this variety on last measuring the development of disease was 51.3 % in average of three years. The lowest development of disease was on variety Podolyanka – 33.1 %.

Table 1

Scheme of experiment study of fungicides effectiveness for potato protection

№ variant	Time of treatment		
	plant height 15–20 cm	budding	end of flowering
I C)	treatment by water	treatment by water	treatment by water
II	Shirlan 50 % KS (fluasnam, 500 g/l), 0,4 l/ha	Ridomil Gold 68 % WG. (mankoceb, 640 g/kg + metalakcil-M, 40 g/kg), 2,5 kg/ha	–
III	Shirlan 50 % KS (fluasnam, 500 g/l), 0,4 l/ha	Ridomil Gold 68 % WG. (mankoceb, 640 g/kg + metalakcil-M, 40 g/kg), 2,5 kg/ha	Shirlan 50 % KS (fluasnam, 500 g/l), 0,4 l/ha
IV	Shirlan 50 % KS (fluasnam, 500 g/l), 0,4 l/ha	Revus 25 % KS (mandipropamid, 250 g/l), 0,6 l/ha	–
V	Shirlan 50 % KS (fluasnam, 500 g/l), 0,4 l/ha	Revus 25 % KS (mandipropamid, 250 g/l), 0,6 l/ha	Revus Top 50 % KS (mandipropamid, 250 g/l + difenoconazol, 250 g/l), 0,6 l/ha

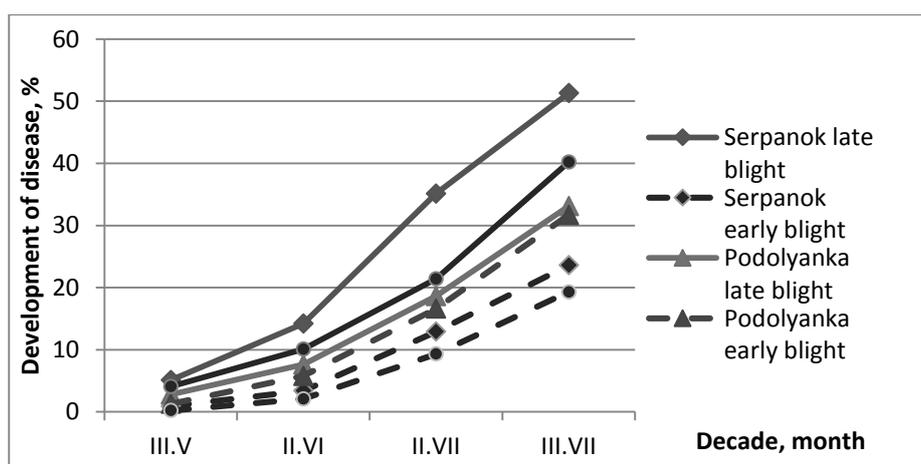


Fig. Influence of varieties features on development of late blight and early blight of potato (Khmelnitsky region, 2013 – 2015).

Analyzing the dynamic of early blight development may distinguish variety Skarbnitsya. Development of disease was lowest in average on three years of research – 19.3 %. The most infected on last measuring was variety Podolyanka – 31.7 %.

Application all investigated potato protection systems from main diseases was effective in all variants compare with control. Technical effectiveness of treatment by fungicides in experiment was 52.3–81.9 % (table 2). Treatments by fungicides were more effective to late blight. Their effectiveness to early blight was lower.

Table 2

Effectiveness of fungicides application for potato protection from late blight and early blight (Khmelnitsky region, 2013 – 2015)

Variant	Podolyanka				Serpanok				Skarbnitsya			
	late blight		early blight		late blight		early blight		late blight		early blight	
	R, %	E**, %	R, %	E, %	R, %	E, %	R, %	E, %	R, %	E, %	R, %	E, %
I (C)	33,1	–	31,7	–	51,3	–	23,7	–	40,2	–	19,3	–
II	7,7	76,7	13,7	56,8	14,8	71,2	9,7	59,1	11,8	70,6	6,8	64,8
III	6,0	81,9	11,3	64,4	11,9	76,8	8,1	65,8	8,7	78,4	6,0	68,9
IV	8,0	75,8	15,9	49,8	15,4	70,0	11,3	52,3	13,3	66,9	7,4	61,7
V	6,6	80,1	10,0	68,5	12,9	74,9	7,4	68,8	9,5	76,4	5,5	71,5

R* – disease development, E** – technical effectiveness

According late blight more effectiveness on all varieties was combination of fungicides Shirlan 50 % KS + Ridomil Gold 68 % WG + Shirlan 50 % KS. To early blight the best was sequential treatment of potato plant by fungicides Shirlan 50 % KS + Revus 25 % KS + Revus Top 50 % KS – 68.5–71.5 %.

Conclusions. In conditions of “Agrarian Company “Proskuriv” in Khmelnytsky region during 2013 – 2015 less development of late blight was on variety Podolyanka, early blight – on variety Skarbnitsya.

Studying of fungicides effectiveness for protection of potato from diseases detected that highest technical efficiency was provided by triple treatment of potato sowing compare with double treatment. The best protection from late blight provided by system of treatment with third application (end of flowering) by Shirlan 50 % KS, from early blight by Revus Top 50 % KS.

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THE INFLUENCE OF PRE-SOWING CULTIVATION OF SEEDS WITH GROWTH REGULATORS ON THE SPRING BARLEY RESISTANCE TO FUNGAL DISEASES IN THE CONDITIONS OF WESTERN FOREST-STEPPE OF UKRAINE

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Bibl. 9. P. 136–140.

The formulation of the problem. Barley is one of the major food and feed crops in Ukraine. The spring barley, in particular, the brewery direction using is grown in Ivano-Frankivsk on large areas. This is facilitated by the steady demand for its corn and the favorable soil and climatic conditions. However, to obtain stable yields of the spring barley should conduct its comprehensive protection from fungal diseases (flying planting and stem rust), which are the most prevalent in the area of Western Forest.

The main material. The research was conducted since 2011 in the fields of grain crop rotation JSC "Stepan Melnychuk" (the village Turka of Kolomyia district of Ivano-Frankivsk region), located in the Western part of the Forest. The soil in test plots is dark gray-ashed black soil, typical for the area of the Western steppe, medium provided with nutrients.

The results of the analysis of humus content in the topsoil was on average 3,2–3,6 %; average nitrogen – 75–80 mg/kg; phosphorus – 120–135 mg/kg; potassium – 175–188 mg/kg. The soil, which conducted the research is slightly acidic (pH 5.7), has a fragile structure and easy swims in the rain, drying and forming a crust. The ecological and agrochemical score of the soil is 54.

We also investigated the effect of pre-sowing cultivation of seeds of spring barley varieties Zvershennya and Cezar with regulators of growth and development of plants (Agrostimulin, Emistim-C, Vermistim and Vermistim-K) for resistance to major cereal fungal diseases.

The seeding rate amounted 4.0 million similar seeds per 1 hectare. We used seeds of the first reproduction with the weight of 1000 grain 48–50 g, the force of growth is

80 %. Before the sowing seeds were cultivated by Vitavaks 200FF (3.0 l/t). The evaluation of plant resistance to disease carried out according to the procedure of the State testing of plant varieties of grains, cereals and legumes.

During all the years of research, there is the little affection of the spring barley by the volatile smut. The highest grade of Zvershennya plant resistance to the flying planting (8.8 points vs. 7.5 in control) was in the form, where preparations are practiced Vermistim-K with norm 5 liters per ton and Vermistim K-7 with norm liters per ton at lower standards disinfectants 10 percent.

The sort Cezar showed the highest resistance (9 points) to the fly planting in the version which applied preparations Vermistim-K with norm 5 liters per ton and Vermistim-K with norm 7 liters per ton, while the control variant had an average score of stability – 7.8.

In 2012 and 2014 there were a significant defeat plants by helminthspodium (the striped mesh and spot). The most resistant to the disease (7 points) were plant varieties of Zvershennya and Cezar in variants where seeds were treated with the preparation Vermistim with norm 8 liters per ton and Vermistim-K with norm 7 liters per ton. The check option in a variety of Zvershennya has average resistance to helminthosporium 6 points and the sort of Cezar 5.8 points.

In crops of barley in 2011 and 2013, there was slight linear lesions plants rust, but in 2012 and 2014 that disease has gained widespread.

The most resistant to linear (stem) rust are plants whose seeds were treated with preparation Vermistim-K with norm 7 liters per ton (8 points). The check option in a variety of Zvershennya was 7.3 points and in Cezar was 7.8 points.

Overall, pre-sowing cultivation of seeds of spring barley varieties of Zvershennya and Cezar helped reduce growth regulators in crops of plants affect by volatile planting, and linear (stem) rust.

According to years of the research it is because preparations based on waste products of the fungi and humic products contain a membership of macro- and micronutrients, vitamins, plant hormones and other substances necessary for plants to improve initial growth and contribute to their better resistance to adverse conditions.

Conclusions. The use of growth regulators for pre-sowing of the spring barley seed cultivation has a positive effect on growth and root development and, therefore, improves a vigor, which ultimately leads to greater plant resistance to disease.

In addition, the seed cultivation of regulators plant growth and development along with seed protectants in plants or directly in the economy can significantly reduce the cost of disinfectants (the rate which is possible in this case reduced by 10–15 %) and improve the protection of plants against fungal diseases in the spring barley the most important periods of the growing season – initial growth and during the ripening grain.

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CHAPTER 7 FODDER PRODUCTION

DENSITY OF CEREAL-LEGUME SHOOTS OF AGROPHYTOCENOSES DEPENDING ON FERTILIZATION

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P. 141–145. Bibl. 7.*

Problem statement. For the purpose of stable escalating of production for needs of the internal market, for physiological norms of nutrition, increase exports and improve the efficiency of animal husbandry sector developed "Strategic directions of development of agriculture of Ukraine till 2020" and "Concept of development of forage production in Ukraine until 2025 ", one of the ways the implementation of which is increase of production volumes and improve the quality of forage. In this connection important question arises of developing new and improvement of existing technological methods creation and use of seeded meadow agrophytocenoses.

Principal of presentation of the material. Grass mixture consisted of *Lotus corniculatus*, *Medicago sativa*, *Festuca arundinacea*, *Bromus inermis* and *Lolium perenne*.

Scheme experiment included studying different options for fertilizing cultivated legume-cereal agrophytocenoses: 1. Control; 2. P₆₀K₆₀; 3. P₆₀K₆₀N₆₀ammonium nitrate; 4. P₆₀K₆₀N₆₀ Lime ammonium nitrate; 5. P₆₀K₆₀N₆₀ urea; 6. P₆₀K₆₀N₆₀ foliar urea.

One of the indicators that describe the state of meadow grass is its density shoots. Our research revealed that fertilization methods that are studied in the experiment influenced the formation of density shoots of cereal-legume grass.

By including in grass mixture two species of legumes – *Medicago sativa*, *Festuca arundinacea* and three species of grasses – *Festuca arundinacea*, *Bromus inermis* and *Lolium perenne* multi-density agrophytocenoses meadow shoots density was high. Thus, in the first year of use (the second year of life) agrophytocenoses meadow in 1 m² shoots were 1597–2156.

Among the studied methods fertilizing of legume-cereal agrophytocenoses in the first year of the use introduction of chemical nitrogen in the form of lime ammonium nitrate was the most effective among the options with the use of nitrogen fertilizers. The density shoots of planting alfalfa and *Festuca arundinacea* on this option was

1089 pcs./m², while the application of ammonium nitrate and urea these figures were respectively 875 and 947 pcs./m².

Because of the extreme weather conditions that occur in the second year of use (third year of life) cultivated meadow agrophytocenoses (2015) observed a decrease in the total density of standing shoots, compared with the previous year, except for the option of making lime ammonium nitrate.

The smallest number of shoots per 1 m² marked on the control variant without fertilizers – 1512 pcs., a most when you make a complete fertilizer, ammonium nitrate P₆₀K₆₀N₆₀lime ammonium nitrate – 2493 pcs. On this option nitrogen nutrition marked the largest number of shoots bean component – 1410 pcs./m².

The most effective way fertilizing cultivated meadow agrophytocenoses in the context of preserving the maximum number of agronomic teams meadow grass and the total density of stems turned introducing a complete fertilizer P₆₀K₆₀N₆₀ lime ammonium nitrate. On specified variant of the experiment was the total density shoots at the level of 2442 pcs./m². Of these accounted for bean 1086 units., on cereals – 1356 pcs.

Conclusions. In result of studies found that in natural moistening of forest-steppe west on ashed with slightly acidic reaction of soil solution in order to get the stand with a high density of shoots, seeded of legume-grass agrophytocenoses advisable to fertilize complete mineral fertilizer N₆₀P₆₀K₆₀, with a source of mineral nitrogen should be used lime-ammonium nitrate.

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CHAPTER 8 AGROCHEMISTRY AND SOIL SCIENCE

EFFECT OF ENVIRONMENTALLY SOUND TECHNOLOGIES IN THE BALANCE OF NUTRIENTS IN THE GRAY FOREST SOIL IN WESTERN FOREST-STEPPE OF UKRAINE

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Problem setting. Efficient land management, introduction of new progressive and ecologically-safe technologies, focused on providing of optimal soil conditions for growth and development of crop plants, are the most important tasks of modern agrarian science.

Economic reforms, having happened in Ukraine and transition to market relations in agriculture have resulted in appearance of the problems as to maintenance and rise of soil efficiency [2]. Arable farming has come back to extensive methods to obtain yield of agricultural crops, working by means of soil reserves of nutrients, fixation of biological nitrogen and poor amount of nutrition elements, input with fertilizers. All the conditions have caused considerable soil exhaustion and become to be a sharp limiting factor to obtain even medium yield [3].

Analysis of the latest researches and publications. According to conclusions of some scientists [5; 6; 9; 13], rise of biological productivity of cereals to 7–10 t/ha is quite possible even if nitrogen and potassium, removed from the soil with yield, come back into the soil with some deficiency, which can make 14 kg/ha for nitrogen indicators and 21–22 kg/ha for potassium. Nitrogen deficiency can be substituted by nonsymbiotic fertilizers of nitrogen fixers, and potassium – by unavailable reserves in soil. However, phosphorus, removed with yield, should be compensated completely and even with excess (110 %) in the soil with fertilizers [1].

Study of nutrients balance has become particularly important in Ukraine in the last decades, that is connected with fall of production growth and application of fertilizers. Calculation of the balance enables an argued choice of fertilizer norm to obtain the expected yield and regulate soil fertility [6].

Task setting. Nowadays, maintenance and restoration of soil fertility is impossible without consideration of microbiological processes, taking place in it, choice and correct

application of measures, regulating their activity. Thus, application of nitrogen-fixing and phosphorus-mobilizing bacteria is an efficient agrarian measure, supporting better plants nutrition [12].

Application of organic fertilizers is not of less importance. They cannot be substituted with mineral fertilizers. Accumulated experience of production proves that application of humic fertilizers for agricultural crops supports better mineral nutrition of plants, improves agrochemical content of soil and secures obtaining of ecologically-safe products of high quality [4].

Scientific base to develop models of extensive restoration of soil fertility is first made by security of positive balance of nutrition elements. Calculation of nutrients balance in soil should be considered as the most efficient control for its fertility conditions. Balance of nutrients should supply not just rise of yield, improvement of quality of agricultural crops, but also progressing increase of soil fertility [5; 9; 13].

Methods of the research. Study of the effect of different technologies to grow spring triticale on productivity and indicators of balance of main elements of mineral nutrition was carried out in 2012 – 2014 under conditions of farming enterprise “Nadbannia”, Koniukhy village, Lokachi district of Volyn region. It is located in soil-climatic zone of the Western Forest-steppe of Ukraine with prevailing grey forest soil, being typical for the location.

Soil of the plot under experiment was grey forest light loamy one.

The experiments were started according to the following scheme: 1. No fertilizers (control); 2. Manure, 15 t/ha; 3. $N_{75}P_{50}K_{90}$; 4. Humic fertilizers, 10 t/ha; 5. Humic fertilizers, 10 t/ha + $N_{50}P_{25}K_{60}$; 6. Azoter, 10 l/ha + N_{40} ; 7. Manure, 5 t/ha + Azoter 10 l/ha; 8. Manure, 5 t/ha + $N_{75}P_{50}K_{90}$ + Humic fertilizers, 5 t/ha.

Territory of the cropping area made 40 m², recorded one – 25 m². The experiment was repeated three times with systematic location of the variants. Humic fertilizers, being used in the research, were produced on the base of putrid mud. They include salts of humic and fulvic acids (carbon of humic acids – 0,24 %), main elements of mineral nutrition (N – 30 %; P₂O₅ – 0,05 %; K₂O – 0,11 %), microelements, vitamins, amino acids and some other physiologically active substances.

Microbiological agent Azoter includes three kinds of bacteria strains. Azotobacter croococcum ($1,54 * 10^{10}$ CFU in 1 cm³), which participates in nonsymbiotic fixation of atmosphere nitrogen; Azospirillum Braziliense ($2,08 * 10^9$ CFU in 1 cm³) movable bacterium, participating in nonsymbiotic fixation of atmosphere nitrogen and withstanding temperature above 30 °C; Bacterium Megatherium ($1,58 * 10^8$ CFU in 1 cm³) – aerobic bacteria, transforming essential macrobiotic elements of soil (e.g. P) and supporting their transformation into insoluble forms, available for root system of plants.

In the variants with expected application of mineral fertilizers, primary cultivation of spring triticale was made with application of ammonium nitrate (a.s. 34 % N), granular superphosphate (a.s. 19 % P₂O₅) and potassium magnesia (a.s. 34 % N). Direct effect of the fertilizers was studied while growing two cultivars of spring triticale Oberih Kharkivskiyi and Losynivske, selected by the Institute of Crop Production named after V.Ya. Yuriev of the NAAS of Ukraine.

Agrotechnology of growing was common for the zone of the Western Forest-steppe of Ukraine and was successfully approbated at the farm. Laboratory-analytical researches were carried out in scientific-research laboratory of the affiliate the Department of Agrarian Chemistry and Soil Science of LNAU at Poliskyi Research Station of National Scientific Center "Institute of Soil Science and Agrarian Chemistry named after O.N. Sokolovskiy", as well as testing laboratory of Volyn subdivision of SU "Institute of Protection of Soils in Ukraine", according to the requirements of the SSTU ISO/IEC 17025-2006 [7] in the field of testing of products of crop production and animal breeding, water and soil as to their ecological-toxicological indicators, testing of means of plant protection, fertilizers, testing of soils according to agrochemical and radiological indicators.

Main material. Calculating balance of nitrogen, phosphorus, potassium for growing of spring triticale under conditions of the research, we determined principal ways of the elements input, such as application of mineral (ammonium nitrate, superphosphate and potassium magnesia) and organic fertilizers (manure, humic fertilizer); come of nutrition elements from atmospheric precipitation and seedling material; nonsymbiotic and biological nitrogen fixation of nitrogen and ways of loss, such as removal of nutrients with yield of spring triticale, loss of them because of top and inner soil wash-off and denitrification. Calculations were made according to the corresponding values and coefficients, presented in reference and methodology literature [1; 5; 10; 11]. According to the results of the made calculation, we determined balance of nitrogen, phosphorus and potassium as a difference between input of the amount of nutrition element and its loss per one hectare (table 1 - 2).

Results of the made calculations prove that growing of spring triticale of both cultivars (Oberih Kharkivskiy and Losynivske) demonstrated similar tendency as to the balance of essential elements of nutrition. Under application of a certain norm of mineral fertilizers ($N_{75}P_{50}K_{90}$), one observed positive balance of all three elements of nutrition. While growing spring triticale of Oberih Kharkivskiy cultivar nitrogen balance made +0,6 kg/ha, phosphorus – +7,4 kg/ha, potassium – +12,4 kg/ha, under intensity of the balance 100,6 %, 115,7 %, 113,0 % respectively. Speaking about Losynivske cultivar, the variants demonstrated balance of nitrogen +7,9 kg/ha, phosphorus – +9,6 kg/ha, potassium – +16,7 kg/ha, and intensity of the balance made 104,9 % for nitrogen, 121,4 % for phosphorus and 118,3 % for potassium.

Positive balance of nitrogen was observed under application of 15 t/ha of manure, i.e. +6,1 kg/ha (Oberih Kharkivskiy cultivar) and +7,9 kg/ha (Losynivske cultivar), as well as while applying 10 t/ha of humic fertilizer and $N_{50}P_{25}K_{60}$ it made +6,9 kg/ha and +10,7 kg/ha. In the variant with application of 5 t/ha of manure, humic fertilizer and $N_{75}P_{50}K_{90}$ the balance made +3,1 kg/ha and +4,1 kg/ha while growing corresponding cultivar of spring triticale. Intensity of the balance in the variants varied within 100,6–108,0 %.

Table 1

Balance of nutrients in grey forest light loamy soil while growing
spring triticale of Oberih Kharkivskiyi cultivar (average for 2012–2014)

Variant	Balance items, kg/ha						Balance kg/ha			Balance intensity, %		
	Input			Losses			N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O
	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O						
Control (no fertilizers)	23,6	1,8	1,2	85,1	41,1	84,0	-61,5	39,3	-82,8	27,7	4,3	1,4
Manure, 15 t/ha	100,1	18,3	38,7	94,0	42,6	93,1	+6,1	-24,3	-54,4	106,5	43,0	41,6
N ₇₅ P ₅₀ K ₉₀	104,6	54,2	108,0	104,0	46,9	95,6	+0,6	+7,4	+12,4	100,6	115,7	113,0
Humic fertilizer, 10 t/ha	94,4	26,6	54,0	101,8	49,6	101,1	-7,4	-23,0	-47,1	92,7	53,7	53,4
Humic fertilizer, 10 t/ha + N ₅₀ P ₂₅ K ₆₀	144,4	51,6	114,0	137,5	65,3	132,5	+6,9	-13,7	-18,5	105,0	79,1	86,0
Azoter, 10 l/ha + N ₄₀	189,6	4,2	18,0	142,1	68,2	138,2	+47,5	-64,0	-120,2	133,4	108,9	42,0
Manure, 5 t/ha + Azoter, 10 l/ha	175,1	9,7	30,5	179,1	89,2	180,2	-4,0	-79,5	-149,7	97,8	89,4	39,1
Manure, 5 t/ha + N ₇₅ P ₅₀ K ₉₀ + humic fertilizer, 5 t/ha	162,5	70,9	138,5	159,4	75,2	152,4	+3,1	-4,3	-13,9	101,9	94,3	90,9

Table 2

Balance of nutrients in grey forest light loamy soil while growing
spring triticale of Losynivske cultivar (average for 2012–2014)

Variant	Balance items, kg/ha						Balance, kg/ha			Balance intensity, %		
	Input			Losses			N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O
	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O						
Control (no fertilizers)	23,6	1,8	1,2	84,1	40,5	83,0	-60,5	-38,7	-81,8	28,1	4,4	1,4
Manure, 15 t/ha	100,1	18,3	38,7	92,2	44,7	91,3	+7,9	-26,4	-52,6	108,6	40,9	42,4
N ₇₅ P ₅₀ K ₉₀	104,6	54,2	108,0	99,7	44,7	91,3	+4,9	+9,6	+16,7	104,9	121,4	118,3
Humic fertilizer, 10 t/ha	94,4	26,6	54,0	104,3	50,9	103,6	-9,9	-24,3	-49,6	90,5	52,3	52,1
Humic fertilizer, 10 t/ha + N ₅₀ P ₂₅ K ₆₀	144,4	51,6	114,0	133,7	63,4	128,7	+10,7	-11,8	-14,7	108,0	81,5	88,6
Azoter, 10 l/ha + N ₄₀	189,6	4,2	18,0	136,5	65,3	132,5	+53,1	-61,1	-114,5	138,9	113,7	43,8
Manure, 5 t/ha + Azoter, 10 l/ha	175,1	9,7	30,5	176,4	87,8	177,4	-1,3	-78,1	-146,9	99,3	90,8	39,7
Manure, 5 t/ha + N ₇₅ P ₅₀ K ₉₀ + humic fertilizer, 5 t/ha	162,5	70,9	138,5	158,4	74,7	151,4	+4,1	-3,8	-12,9	102,6	95,0	91,5

The highest indicators of positive nitrogen balance was observed while applying Azoter on the base of 40 kg/ha a.s. of nitric fertilizers: growing Oberih Kharkivskiyi cultivar it made +47,5 kg/ha (balance intensity – 133,4 %) and Losynivske cultivar – +53,1 kg/ha (balance intensity – 138,9 %). Speaking about potassium and phosphorus, at all variants, but the one with application of mineral fertilizers (N₇₅P₅₀K₉₀), one observed negative balance of them. The most negative values were demonstrated by the variant with application of microbiological agent Azoter, i.e. phosphorus -64,0 – -79,5 kg/ha (Oberih Kharkivskiyi) and -61,1 – -78,1 kg/ha (Losynivske), potassium -120,2 – -149,7 kg/ha (Oberih Kharkivskiyi) and -114,5 – -146,9 kg/ha (Losynivske).

In all other variants, losses prevailed input of potassium while growing spring triticale of Oberih Kharkivskiyi cultivar and made – 4,3 – 39,3, Losynivske – 3,8 – 38,7 kg/ha, and potassium made 13,9 – 82,8 and 12,9 – 81,8 kg/ha respectively.

Conclusions. Making analysis of the above-mentioned data one can make conclusion that application of a complete scientifically grounded norm of mineral fertilizers secures positive balance in soil according to the main elements of nutrition (nitrogen, phosphorus, potassium). Application of microbiological agent Azoter with N₄₀, is an efficient method, which helps additional intensive accumulation of nitrogen in soil (to 47,5–53,1 kg/ha). The phenomenon can be explained by the fact that activation of living activity of microflora results in intensification of the processes of biological fixation of nitrogen by microorganisms.

Negative balance of phosphorus and potassium in case of application of humic fertilizers and microbiological agent Azoter is explained by some reasons, i.e. humic fertilizers have poor content of the elements (phosphorus – 0,28 %, potassium – 0,45 %) as well as by removal of the elements because of high yield of grain (to 6,78–6,89 t/ha) [8].

Thus, applying bioagents and humic fertilizers one should consider the factors and plan compensation of the input elements of mineral nutrition for ecological stabilization of soil system.

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NITROGEN CHANGE FUND DARK GRAY PODZOLIC SOILS UNDER DIFFERENT FERTILIZING SYSTEMS IN THE FIELD CROP ROTATION

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Bibl. 7. P. 152–155.*

Raising of problem. A study of dynamic changes of maintenance of nitrogen in soil, and also determination of optimal ways of his receipt and providing of plants was and remains the important task of modern agrochemical science [2]. Researches of nitric cycle in soil give an opportunity to define the basic ways of his receipt and unproductive losses, forecast the orientation of agrochemical processes, change of fertility, estimate the ecological consequences of application of fertilizers.

Analysis of the last researches and publications. In soil considerable attention is spared the study of processes of transformation of nitrogen from the side of many researchers [2; 3; 6]. As a biogenic element is important nitrogen participates in forming of biomas and is the component of biochemical composition of living organisms, plays a considerable role the mineral feed of plants, shows a stoichiometrical, synergistic and antagonism action in the biosystems [5; 7].

However without regard to the far of publications that touch the processes of transformation of nitrogen in agrocenosis, researches sanctified to the study of complex estimation of nitric fund in darkly-grey podzolic soil, especially for top-dressing, it is compared.

Raising of task. The task of researches was to set conformities to law of forming of nitric fund of darkly-grey podzolic soil under act of the different systems of fertilizer of cultures in the short rotary press field crop rotation of Western Forest-steppe of Ukraine.

Exposition of basic material. In the conditions of stationary experience of department of agricultural chemistry and soil science of the Lviv national agrarian university the executed researches are from the study of influence of the different systems of fertilizer on the nitric fund of darkly-grey podzolic soil.

The duties of cultures in the short rotary press field change of fruit to the crop rotation was such: a wheat is winter-annual – a beet is saccharine – a barley is furious is a red clover.

The chart of experience envisaged control, mineral, organic and organo-mineral systems of fertilizer with a different satiation by organic fertilizers: 1. Control (without fertilizers); 2. Mineral system of fertilizer of $N_{390}P_{210}K_{430}$ (sum of NPK – 1030); 3. Organo-mineral system of fertilizer of $N_{390}P_{207}K_{430}$, from them it is brought in $N_{270}P_{150}K_{263}$ with mineral fertilizers (sum of NPK – 1030, saturation of crop rotation by organic fertilizers – 6,25 t/ha area of crop rotation); 4. Organo-mineral system of fertilizer of $N_{390}P_{210}K_{430}$ (sum of NPK – 1030), from them it is brought in with the mineral fertilizers of $N_{100}P_{170}K_{173}$, saturation of crop rotation by organic fertilizers – 12,5 t/ha; 5. Organo-mineral system of fertilizer of $N_{390}P_{210}K_{430}$, (sum of NPK – 1030) from them it is brought in with the mineral fertilizers of $N_{50}P_{85}K_{113}$, degree of satiation organic fertilizers – 15,0 t/ha area of crop rotation; 6. Organic system of fertilizer of $N_{390}P_{210}K_{430}$ (sum of NPK – 1030), degree of satiation organic fertilizers – 17,5 t/ha.

As mineral fertilizers in experience used superphosphate simple granular, potassium salt, that brought in a basic fertilizer. Ammoniac saltpetre was brought in under preseed till and in a signup. As organic fertilizers used the half overripe straw pus of cattle, radish oily on green manure and straw of wheat winter-annual.

General area of experience areas – 450 m², registration – 374 m², repeated of experience – triple, placing of areas is systematic.

Labtests conducted after such methodologies: content of gross forms of nitrogen – after the method of Kieldal; factious composition of connections of nitrogen – after the method of Shkonde-Koroliova; remaining connections of nitrogen – colorimetrically with the reagent of Nesler [1; 4].

It is set researches, that, on the average for the rotary press of crop rotation, system of fertilizer substantially influence on maintenance of mineral nitrogen in an epiphase (0–20 cm) soil (see a table.).

The mineral system of fertilizer provided it is certain, but insignificant (on 1,4 mg/kg to soil), increase of content of ammoniacal connections of nitrogen. Bringing of organic fertilizers assisted the increase of this index to 17,6–18,0 mg/kg to soil. The greatest indexes of content of ammoniacal forms of nitrogen are fixed in variants 4, 5 and 6 with a most satiation by organic fertilizers. It specifies on positive influence from bringing of organic fertilizers on motion of ammonifying processes.

Table

Influence of the systems of fertilizer is on content of different factions of nitrogen in darkly-grey podzolic soil, on the average for the short rotary press of crop rotation 2009–2012 years

Variant	Content of different factions of nitrogen is in soil, mg/kg of soil					
	mineral		easily-hydrolyzed	difficult-hydrolyzed	non-hydrolyzed	together
	N-NO ₃ ⁻	N-NH ₄ ⁺				
1	1,7	13,2	107,0	214,6	848,5	1185,0
	2,2	15,1	113,2	222,8	886,5	1239,8
2	2,7	14,6	111,3	221,0	881,4	1231,0
	2,9	17,4	122,0	240,0	936,1	1318,4
3	2,5	16,1	114,0	226,2	900,2	1259,0
	2,5	19,4	128,0	251,0	991,0	1391,9
4	2,4	17,6	118,7	230,0	902,7	1271,4
	2,4	18,8	136,8	262,0	1028,4	1448,4
5	2,2	18,0	122,0	246,0	950,4	1338,6
	2,3	21,6	139,0	276,2	1090,9	1530,0
6	2,1	17,6	120,8	250,0	956,0	1346,5
	2,2	17,4	137,5	268,1	1067,2	1492,6
LSD _{0,05}	0,07	0,6	5,1	7,5	32,3	
	0,1	0,8	2,4	6,8	22,3	

Note: a numerator is a 0 – 20 sm; a denominator is a 20 – 40 sm.

Without regard to reduction of indexes to content of nitrate forms of nitrogen under act of the organo-mineral system of fertilizer comparatively with mineral, common content of mineral connections of nitrogen grew, mainly due to piling up of ammoniacal. In variants 4 and 5 this index presented 20,0–20,2 mg/kg to soil that testifies to the best provision of nitrogen comparatively with other variants.

Light-hydrolyzed of form of nitrogen serve as the nearest reserve of mineral connections of nitrogen for the feed of plants. The greatest indexes of content of this faction were fixed in a variant 5, that testifies to positive influence of compatible application of organic and mineral fertilizers. The organic system (variant 6) did not provide the increase of content of light-hydrolyzed forms of nitrogen comparatively with organo-mineral.

Content of non-hydrolyzed connections of nitrogen hesitated within the limits of 848–956 mg/kg to soil. Such wide difference largely influenced on the general supplies of nitrogen in soil, that closely correlated with the indexes of non-hydrolyzed.

The fund of nitrogen of darkly-grey podzolic soil substantially changed depending on the different systems of fertilizer. In particular, in control common maintenance of nitrogen presented 1185,0 mg/kg. The mineral system provided the increase of this index to 1231,0 mg/kg to soil, or on 46 mg/kg to soil. Application of the organo-mineral system

of fertilizer assisted the increase of index of general maintenance of nitrogen to 1338,6–1346,5 mg/kg to soil, that on 12,9–13,6 anymore from a control variant.

Examining the indexes of content of different factions of nitrogen in a under arable (20–40 cm) layer, it should be noted that tendencies to the change of nitric fund were similar. However the increase of absolute indexes of maintenance of nitrate and ammoniacal nitrogen in a under arable layer assisted the increase of maintenance of mineral nitrogen in a under arable layer and the best providing by this element.

In the structure of nitric fund of soil the mineral forms of nitrogen presented 1,3–1,6 light-hydrolyzed – within the limits of 9,0–9,4, difficult-hydrolyzed – 18,0–18,6, non-hydrolyzed – 71,0–71,6 %. Without regard to considerable divergences in the absolute indexes of maintenance of nitrogen of different factions, their relative content hesitates in insignificant limits, that, obviously, it is determined by the genetic features of soil.

Conclusions. As a result of conducted studies it is set that part of different factions of nitrogen in his general fund of darkly-grey podzolic soil changes in an minor range, without regard to applications of the different systems of fertilizer and grown cultures. It confirms that the transition of nitrogen from different factions takes place quickly and predetermined by agrochemical properties of soil, in particular by the state of him organic substance. For providing of positive change of general maintenance of nitrogen in soil organic fertilizers are an irreplaceable factor, assist the reliable piling up of this element comparatively with the same amount of the fertilizers brought in form mineral connections. The optimal index of maintenance of nitrogen in the different fields of short rotary press short crop rotation was provided by the organo-mineral system of fertilizer with a satiation the organic fertilizers of 15 t/ha crop rotation.

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AFTEREFFECT OF FERMENTED ORGANIC MANURE ON AGROCHEMICAL INDICATOR OF SOD-PODZOL SOIL OF WESTERN POLISSIA OF UKRAINE AND PRODUCTIVITY OF RED CLOVER

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Objectives Our research is aimed at studying the influence of conventional (manure) and non-conventional (fermentable) organic manure combined with mineral fertilizers on agrochemical characteristics of soddy-podzolic soils and productivity of meadow clover.

Materials and Methods of Research Phenomenon of the influence of fermentable organic manure aftereffect on the productivity of meadow clover was researched under conditions of field experiments on the materials of soddy-podzolic sandy loam soils in Manevychi district, Volyn region .Our experiment got the following variants: 1. Monitoring (without any fertilizer); 2. Manure – 30 t/ha; 3. Fermentable manure – 7,5 t/ha; 4. Fermentable manure – 15 t/ha; 5. Fermentable manure – 22,5 t/ha; 6. Manure – 30 t/ha + N₉₀P₆₀K₁₂₀; 7. Fermentable manure – 15 t/ha + N₉₀P₆₀K₁₂₀

Results of Research Organic manures applied for the previous crops in crop rotation caused lowering of the researched soils degree of acidity. Application of 30 t/ha of manure raised the degree of ph ((the 2nd variant) on 0,7 of the sample. Fermentable fertilizers caused decreasing of exchangeable acidity degree in 0,6 – 1,2. The standard of 22,5 t/ha of fermentable manures proved to be the most effective. Soils here had the chance to cross the medium-acid phase in the variant of monitoring and approached the neutral phase due to the neutral reaction of the very fermentable fertilizer containing calcium.

Such modification of the soil solution reaction caused the high productivity of meadow clover.

The additional application of mineral fertilizers on the background of 30 t/ha of manure and 15 t/ha of fermentable manure somehow acidified soils in comparison with the background variants due to the nature of the very mineral fertilizers.

Organic manures applied for the first crops in crop rotation facilitated the increase the humus content in soils in all variants of research. Application of 30 t/ha of manure and fermentable fertilizers with equivalent content of nitrogen (7,5 t/ha) caused increase of humus content in 0,03 % during 4-years period of research comparing with the variant of monitoring. Enlargement of the standard of fermentable fertilizer application caused enlargement of humus content in 0,1 %. Thus, fertilization of meadow clover with conventional and non-conventional organic manures caused increase of humus content and reproduction of fertility of soddy-podzolic sandy loam soils.

We also revealed the influence of organic and mineral fertilizers on the content of basic elements of soils nutrients of experimental plot. All fertilized experimental

variants witnessed positive balance of alkaline hydrolyzed nitrogen, movable phosphor and exchangeable potassium in soils.

Fertilization of the previous crops in crop rotation (potatoes) influenced productivity of meadow clover (the 3rd crop in crop rotation).

The yield of the green and dry mass is guaranteed by the aftereffect of 22,5 t/ha of fermentable fertilizer (the 5th variant) – 64,2 and 13,2 t/ha accordingly due to the decent content of nutrients in the plants of meadow clover during whole period of vegetation. Organically-mineral system of fertilization of the previous crop in crop rotation (the 6th and 7th variants) cause decrease of the green and dry substances yield to 54,9 and 55,7 as well as 11,0 and 11,2 t/ha. The lowest yield among fertilized variants was achieved in the 2nd variant where conventional organic manure were applied in the standard of 30 t/ha of manure; 47,7 t/ha of the green mass and 9,4 t/ha of dry substances due to prolonged period of nutrients' separation from manure, particularly under conditions of moisture scarcity when plants are deprived of nutrients at the early phase of their growth. Such regularity is characteristic for modifications in the yields of fodder crops.

Concerning some aspects of quantitative characteristics of fodder nutrients one must speak primarily of the positive effect of fermentable fertilizers of the content of dry substances in the green mass of meadow clover. Under conditions of conventional organic manures (the 2nd variant) the content of dry substances proved to be 19,7 %; under conditions of fermentable fertilizers it was 19,8–20,6 % depending on the standard of application. Simultaneous application of conventional and fermentable fertilizers together with the mineral ones guarantees 20,1–20,4 % content of dry substances in green mass (the 6th and 7th variants).

Content of fodder samples in 1 kg of the green mass fodder when applying organic manures in the standard of 30 kg/ha is increased to 0,19 gr. Under conditions of non-conventional fermentable fertilizers the content of fodder samples is enlarged to 0,20–0,21.

Simultaneous application of mineral and organic fertilizers did not cause modifications in this characteristic. The research also revealed considerable effect of fertilizers on the content of digested protein both in fodder and one separate fodder sample.

The highest content of digested protein (21g) and balance of fodder sample according to this characteristic (102 g) is achieved under conditions of applying 22,5 t/ha of fermentable fertilizers.

Conclusions Fermentable fertilizers in aftereffect (the 3rd year) cause the increase of humus content and decreases acidity of soddy-podzolic sand loam soils more effectively than in the case of applying conventional organic fertilizers (manure). The most effective standard of application is 22,5 t/ha. Such system of fertilization of the previous crop in crop rotation causes the increase of nutrients reserve in soils. The increase of efficiency of their application guarantees the high level of meadow clover productivity in over 64 t/ha of the green mass, 13 t/ha of dry substances and 12 t/ha of fodder samples. One fodder sample provision with digested protein is 102 g.

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BIOENERGETIC EFFECTIVENESS OF GROWING WILLOW ENERGY FOR MAKING ON SEWAGE SLUDGE OF SOD-PODZOLIC SOILS OF PRECARPATHIAN

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Problem. One of the most pressing challenges the state is the search for alternative of renewable energy while addressing environmental issues and the development of energy-saving technology. In particular, is actively seeking effective ways the use of high performance bioenergy crops with a view growing biomass for biofuel production [1; 6].

Energetic plants, including willow energy can grow on unproductive lands in Ukraine there are hundreds of thousands hectares. To promote higher productivity of this crop can making sewage sludge (ERU) as fertilizer, as the country suffers from an excess. This organic material in of communal treatment plants economy. However environmentally safe use of sewage sludge is poorly understood [2; 8].

Recent research analysis and publications. It is known that 5–10 years of proven oil reserves will be exhausted by more than 60 % since increasing the need to involve non-traditional energy sources, including based on biomaterials [1; 3–5]. Of all power

plants willow world it is now used as a primary energy culture for the production of solid fuels [6; 8].

A large spread this culture gained in the Scandinavian countries, where it is recommended to grow in swampy and unproductive lands. Biomass energy willow chips as a fuel is the main raw material for the production of green energy to power stations in of Denmark, Belgium, Finland, England, Germany, Austria and Poland. Significant progress in growing energy willow achieved Sweden by increasing planting area over the past decades several times, which today is approximately 180–200 thousand hectares [8; 9].

For several decades (at least 25) willow plantations energy can be used for energy purposes. Even 5 – 8 cycles using plantation that culture will not reduce its performance. According to researchers the highest level of performance and energy value indicated willow biomass energy use after three years [6; 8; 9].

In Ukraine, despite the large amount of unused agricultural lands, industrial plantations of energy crops is still insufficient [7; 9]. Adding ERUs under willow energy allows, on the one hand to reduce the pollution of surface and ground water, and on the other – provides a significant amount of available biomass resources, which can be widely used for energy purposes. Willow improve the ecological condition of soils due to deep root system that can absorb large amounts of nutrients from SALT [2; 8].

Setting objectives. The main objective of the paper is to determine energy efficiency of growing energy willow for making different standards of SS and compost made on the basis of different organic material.

The main material. Experiment founded in 2011 in 3times the repetition. The scheme of planting the willow energy is 0.33 x 0.70 m, area of 28 m². In the research Collectible field of Ivano-Frankivsk College LNAU in Chukalivka village Tysmenytsya area.

Variants of experiments: 1. Control – no fertilizers; 2. Mineral fertilizers – N₁₀₀P₁₀₀K₁₀₀; 3. SS – 40 t/ha; 4. SS – 60 t/ha; 5. SS – 80 t/ha; 6. Compost SS + sawdust (3:1) – 60 t/ha; 7. Compost SS + straw (3:1) – 20 t/ha; 8. Compost SS + straw (3:1) – 40 t/ha; 9. Compost SS + straw (3:1) – 60 t/ha; 10. Compost SS + straw (3:1) + 10 % cement dust – 40 t/ha.

To determine the dynamics of formation of vegetative productivity mass of plants we selected runners on second, third and fourth years of growth. Their weighed and dried to constant weight (table 1).

Intensive growth of vegetative mass is held for the second year vegetation, virtually all versions of the experiment. The largest increase was observed in ways which made fertilizers and fresh SS.

Adding compost is also provided with the basics of intensive growth of vegetative mass of 1.0 – 2.5 t/ha compared to the control. Size willow vegetative mass energy in the reference version for fourth year vegetation is about 44 t/ha, 26.9–50.8 % from option 3–5, where fresh made SS.

By making compost from SS and sawdust (3:1) at a rate of 60 t/ha yield rate was 82.8 t/ha, which is 38.8 t/ha compared with a control option. The value of energy willow yields for the third and fourth years of growth in almost every variant increased twice.

The release of the most productive dry biomass energy willows are options 5 and 6, which made SS normally 80 t/ha compost based on SS + sawdust (3:1) 60 t/ha respectively.

Table 1
Effect of fertilization on the productivity of willow energy, average for 2012 – 2014 years

Variants	Productivity of willow energy , t/ha					
	years of researches			Mean	± to control	
	2012	2013	2014		t/ha	%
1. Control – no fertilizers	5,71	27,01	44,03	25,58	-	-
2. N ₁₀₀ P ₁₀₀ K ₁₀₀	14,70	32,25	52,26	33,07	8,2	18,7
3. SS – 40 t/ha	6,42	22,74	68,59	32,58	4,6	55,8
4. SS – 60 t/ha	8,55	27,05	79,74	38,45	5,7	81,1
5. SS – 80 t/ha	11,61	33,48	94,81	46,63	0,8	115,3
Compost SS + sawdust (3:1) – 60 t/ha	13,11	30,57	82,83	42,17	8,8	88,1
Compost SS + straw (3:1) – 20 t/ha	6,65	31,29	73,65	37,19	9,6	67,3
Compost SS + straw (3:1) – 40 t/ha	6,71	37,55	79,61	41,29	5,6	80,8
Compost SS + straw (3:1) – 60 t/ha	8,51	31,54	85,84	41,96	1,8	95,0
6. Compost SS + straw (3:1) + 10 % cement dust – 40 t/ha.	7,55	31,55	79,70	39,60	5,7	81,0

However, making compost from SS and straw (3:1) normal 20–60 t/ha of willow biomass energy also increased to 88,5–114,6 % to 29.1–37,1 t/ha.

Biomass after three years is making of energy value collection at 19.56 MJ/kg dry weight [9]. This figure we used in the evaluation the value of the energy potential of willow plantations at different energy agrocenosis conditions of mineral nutrition.

According to calculations the cost of energy in growing willow version control reached 4737 UAH/ha. By making the SS given all transport and preparation for the introduction, the cost of growing willow energy increased and reached respectively 9875 UAH/ha.

However, making compost costs and reduced cultivation least cost energy was growing willow for making based compost and straw SS normally 20 t/ha. Such indicators of value energy rates were commensurate with that given in study [9].

Cost of production also varied according to variant of experience. In particular, the version control production costs remained the largest and amounted to 143,9 UAH/t, making the SS normal 40 t/ha cost reached 117,7 UAH/t. However, the introduction of 60 and 80 t/ha SS cost of production increased to 121,7 and 122.2 USD/t in accordance.

Table 2

Effect of fertilization on yield energy willow dry biomass 2012–2014 years

Variants	Exit of dry mass, t/ha				± to control	
	years of researches			Mean	t/ha	%
	2012	2013	2014			
1. Control – no fertilizers	4,28	17,54	32,91	18,24	-	-
2. N ₁₀₀ P ₁₀₀ K ₁₀₀	12,04	21,01	44,12	25,72	11,2	34,1
3. SS – 40 t/ha	5,78	17,55	54,59	25,97	21,7	65,9
4. SS – 60 t/ha	7,45	22,77	66,91	32,38	34,0	103,3
5. SS – 80 t/ha	10,97	26,54	80,78	39,43	47,9	145,5
6. Compost SS + sawdust (3:1) – 60 t/ha	12,31	33,66	70,01	38,66	37,1	112,7
7. Compost SS + straw (3:1) – 20 t/ha	5,87	24,49	62,02	30,79	29,1	88,5
8. Compost SS + straw (3:1) – 40 t/ha	5,49	29,03	69,36	34,63	36,5	110,8
9. Compost SS + straw (3:1) – 60 t/ha	7,55	25,54	70,64	34,58	37,7	114,6
10. Compost SS + straw (3:1) + 10 % cement dust – 40 t/ha.	6,81	26,04	65,61	32,82	32,7	99,4

Table 3

The economic and energy efficiency of growing willow energy, 2014

№ Variants	Expenses are on growing		Exit of dry biomass, t/ha	Production cost UAH/t	Exit of gross energies GJ/ha	Prime price of the got energy UAH/GJ	Coefficient of power efficiency (Kee)
	UAH/GJ	GJ/ha					
1	4737	543,7191	32,91	143,9	643,7196	7,4	1,18
2	5344	565,0281	44,12	121,1	862,9872	6,2	1,70
3	6427	639,1492	54,59	117,7	1067,7804	6,0	1,75
4	8141	771,6016	66,91	121,7	1308,7596	6,2	1,70
5	9875	935,9497	80,78	122,2	1580,0568	6,2	1,69
6	8438	799,7512	70,01	120,5	1369,3956	6,2	1,71
7	7394	700,8012	62,02	119,2	1213,1112	6,2	1,73
8	7588	719,1885	69,36	109,4	1356,6816	5,6	1,89
9	7882	747,0537	70,64	111,6	1381,7184	5,7	1,85
10	7734	733,0263	65,61	117,9	1283,3316	6,0	1,75

The lowest production cost of making compost to ensure on SS and straw (3:1) at a rate of 40 t/ha, in terms of experience has provided 109.4 UAH/t. Accordingly, each year gathering willow biomass energy and increased gross output increased energy yield. In embodiments where the compost have made, gross energy output decreased compared with options, which made fresh ERU, but remained higher than control. But in the third year using gross energy output increased most as increased yield of dry biomass. The cost of energy generation is quite low. In our research unit cost of energy in the energy willow was 0,6–0.7 USD/GJ and varied options for the experiment. In particular the introduction of SS Normally 40–80 t/ha energy unit cost was 0,6 USD/GJ by making compost from SS and straw (3:1) at a rate of 20–40 t/ha was 0,56–0,57 USD/GJ respectively.

Conclusions. So, based on economic calculations and conducted assess the energy efficiency of growing energy willow can the following conclusions:

– Cost-effectively grow energy willow for making compost from SS and straw (3:1) at a rate of 20 and 40 t/ha;

– Gross energy output per unit area for growing willow energy is high enough for making fresh ERU, but because to enhance environmental hazard of heavy metals in the soil over MAC environmentally safer to use compost from SS and straw (3:1) at a rate of 20–40 t/ha;

– For the energy efficiency of growing energy willow making compost from SS and straw (3:1) at a rate of 20–60 t/ha the best performance, namely the lowest cost per unit of energy biomass (0.56–0.57 USD/GJ) and the highest energy rates efficiency of 1.9.

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AGROPHYSICAL SOIL PROPERTIES AT DIFFERENT WAYS OF CULTIVATION AND FERTILIZATION IN THE CULTIVATION OF FLAX IN CONDITIONS OF CARPATHIANS

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P. 167–174. Bibl. 10.*

Formulation of the problem. With the transition to modern agriculture to a new level based on biological principles, issues of restoration, conservation and improvement of soil fertility becoming more and more important. After agrophysical high performance is a testament to the quality of the soil. Require substantial effort and work for keeping it that way, that affect the growth and development and productivity of plants and their value enhanced by different methods of cultivation and the use of fertilizers.

Presenting main material. In the article is shown the state of agrophysical exploring the best properties of soil. Analyzed changes in structural aggregate composition, density and porosity it by different methods and basic soil fertilization. During the growing season the best agrophysical rates prevailing in 0–10 cm layer of the application disking 8–10 cm. The density and porosity in subsoil layers was the best by a deep loosening. Growing green manure (oilseed radish) both separately and in combination with mineral fertilizers contributed significantly to improving the studied parameters.

The most effective in growing flax was disking of 8–10 cm in combination with the deep loosening 35–40 cm on the background dose N30P45K60 fertilizers with green manure. The ways to improve soil properties agrophysical to improve the yield of flax in conditions of Carpathians.

Conclusions. The article analyzes the structural state of aggregation, density and porosity of sod-podzolicgley soil surface when growing flax in conditions of Carpathians.

According to the research the application of minimum tillage (shallow plowing and disking) with deep loosening on the background of mineral fertilizers and green manures provide more favorable agrophysical conditions plow and subsoil layer, uniform distribution of batteries in the plow layer, which contributes to the growth and development of plants and yield formation.

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CHAPTER 9 RANCHING

THE EFFECT OF CHROMIUM (VI) IN THE PROCESS OF LIPID PEROXIDATION AND ANTIOXIDANT SYSTEM IN THE CELLS OF INTERNAL ORGANS OF RABBITS

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Bibl. 6. P. 175–178.

Formulation of the problem. Hexavalent Chromium (Cr (VI)) is now considered as one of the most hazardous chemicals. People and animals may be exposed to small amounts of Cr(VI) through consumption of contaminated water, food and feedstuffs, or through inhalation of polluted atmospheric air. Long-term exposure to Cr (VI)-containing compounds leads to metabolic disturbances and may result in mutagenic, carcinogenic and teratogenic effects. The role of oxidative stress in mechanisms of Cr (VI)-induced toxicity has not been studied completely. Therefore the aim of present research was to study the effects of Cr (VI) on process of lipid peroxidation and the activities of antioxidant enzymes in the cells of internal organs of rabbits.

Presentation of basic material. The study was conducted on 15 rabbits (champagne breed) at three months of age. The animals were divided into three groups: control (C) and two experimental (E1, E2) of 5 animals each. Rabbits of group E1 and E2 were treated with Cr (VI) (the daily dose – 5 mg/kg body weight) by intragastric administration of $K_2Cr_2O_7$ solution, respectively, for 14 and 30 days. Animals of control group were treated with saline by the same rout.

The results of study show that prolonged intragastric administration of potassium dichromate causes significant accumulation of lipid peroxidation products in the cells of internal organs of rabbits. In particular, after 30-day period of $K_2Cr_2O_7$ administration, concentration of TBA-active products in liver, kidneys and lungs of experimental animals increases respectively by 48.9, 58.4 and 117.3 %. When analyzing this indicator in connection with experiment duration, it should be noted that content of lipid peroxidation products in the liver and kidney of rabbits increases with the length of exposure to Cr (VI), while formation of TBA-active products in the lungs on the 14-th day occurs more intensively than on the 30-th day of the experiment.

According to the results of the study, Cr (VI)-induced stimulation of lipid peroxidation was accompanied by the changes in functional activity of antioxidant system in the organs rabbits treated with potassium dichromate for 14 and 30 days.

In particular, superoxide dismutase (SOD) activity in liver and kidney cells was

inhibited after 30-day period of $K_2Cr_2O_7$ administration, respectively by 23.9 and 44.8 %, while SOD activity in rabbit lungs increased on the 14-th day of experiment. At the same time catalase activity in liver and kidney of experimental rabbits was suppressed by 1.6–1.9 times, and in lung cells – almost threefold.

The analysis of glutathione-dependent enzymes shows different changes in their activities in the cells of the liver, kidneys and lungs of Cr (VI)-administered rabbits. Glutathione peroxidase (GPx) activity increased on the 14th day of experiment in all organs examined, with most increment in GPx activity occurred in the lungs (by 3.15 times in comparison to control). Glutathione peroxidase activities in kidney and liver of E1 group of rabbits increased respectively by 128 % and 60.4 %. On the 30th day of experiment GPx activity dropped to the control levels in the liver and kidneys, however it was still higher than control (by 28.5 %) in the lungs of experimental rabbits.

Glutathione reductase (GR) activity in the organs of rabbits treated with $K_2Cr_2O_7$ showed a different pattern of change in the course of Cr (VI) intoxication. The enzyme activity increased significantly on the 14th day of experiment in the liver, while it was markedly suppressed in the kidneys and lungs of rabbits on the 30th day of experiment. These changes were accompanied by a decrease in reduced glutathione (GSH) concentration in rabbit kidneys (by 27.3 %) and lungs (by 29.5 %). However, GSH concentration was stable in the liver of rabbits treated with potassium dichromate.

Conclusions. The administration of hexavalent chromium to rabbits at a daily dose of 5 mg/kg body weight during 14 and 30 days caused stimulation of lipid peroxidation with significant increase in TBA-active products in internal organs (liver, kidneys and lungs). Under such conditions SOD and catalase activities decreased in the liver and kidneys of rabbits on the 30th day, and glutathione peroxidase activity increased in all three organs studied on the 14th day of the experiment. Glutathione reductase activity in rabbit liver increased on the 14th day, but it was reduced in the kidneys and lungs on 30th day of the experiment.

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INTENSITY OF CALVES GROWTH AND CHANGES OF FATTY-ACID CONTENT OF BLOOD LIPIDS UNDER THE EFFECT OF VEGETABLE FATTY SUPPLEMENTS IN THE DIET

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Bibl. 6. P. 178–182.*

Problem setting. Numerous researches prove that application of vegetable and animal fatty supplements in the diet of ruminants makes stimulating effect on metabolism, intensity of their growth and development, forage costs, slaughtering weight, food and biological value of animal products [1]. Such effect is explained by high-energy coefficient of fats, their nitrogen-retaining effect in a body, positive impact on regulation of metabolic processes, accumulation of fat-soluble vitamins in tissues [3].

However, it is demonstrated that the increased level of animal and, particularly, vegetable fats in the diet of cattle, in the period of active functioning of forestomachs, inhibits metabolic activity of some rumen microorganisms. It is also determined, that intensive splitting of alimentary lipids and hydrogenolysis of polyene fatty acids in forestomachs of cattle by means of ferment microorganism systems results in degradation of a considerable number of essential (linoleic and linolenic) fatty acids, making negative impact on food and biological quality of milk and beef. Considering all mentioned above, countries with developed cattle breeding have recently carried out intensive scientific investigations on the increase of efficiency of fatty supplements application in diets of the kind of animals.

Analysis of the latest researches and publications. It is known that polyene essential (linoleic and linolenic) fatty acids, which are hydrogenized by ferment systems of rumen microorganisms of ruminants, make positive impact on people's health because of anticarcinogenic, antisclerotic and anti-inflammatory effects. Considering the information, different methods of protection of vegetable and animal fats are applied before animal feeding to decrease negative effect of alimentary fats on metabolic activity of symbiotic forestomach microorganisms of cattle, to rise entrance of polyene fatty acids from a bowel into blood flow and increase a share of the mentioned polyene-rich fatty acids in the content of milk fat and beef [6].

Task setting. Aim of the work is to make comparative investigation of the impact of calves feeding with native sunflower oil and calcium salts of fatty acids, made on the oil base, on changes of fatty-acid content of lipids of blood plasma and intensity of the calves growth.

Main material. The research was carried on 6-month intact calves of black-spotted breed in winter-autumn period, which were divided into three groups (5 heads in each) according to the principle of analogues. In preparation period (30 days) all animals stayed in the same conditions on the essential diet, including hay, maize silage, fodder beet and grain mixture by content: wheat middlings – 50 %, barley middlings – 30 %, oats middlings – 20 %. During the research period of 90 days, animals of the control group got the same diet, as in the preparation period. Calves of the second group got isocaloric diet,

including all mash with sunflower oil in amount of 5 %, while animals of the third group were fed with calcium salts of fatty acids, made on the base of sunflower oil.

To control intensity of growth, calves were weighted at the beginning and at the end of the investigated period. In the animal blood plasma from jugular, taken at the end of the research, one identified lipid variety [2]. The obtained data were statistically handled.

Research results. Data of the research show that supplements of calcium salts of fatty acids, fed to calves, actually rises level of linoleic and linolenic fatty acids and decreases a share of stearic acid in the content of lipids of blood plasma, contrasting to the animals of control group. It can be explained by efficient protection of unsaturated fatty acids in the content of calcium salts.

We have got the data, demonstrating that in experimental period an average daily gain of live weight of animals in the research groups was by 1,8–7,2 % higher than in the control group. In addition, application of calcium salts of fatty acids makes greater impact on intensity of calves growth, comparing to the use of native sunflower oil in their diet. Such effect can be explained by a decrease of negative impact of unsaturated fatty acids on activity of rumen microorganisms while feeding the ruminants with protected vegetable oils.

Generally, the presented results prove that calves feeding with calcium salts of fatty acids makes positive productive and metabolic effect on that kind of animals.

Conclusions. Feeding of 6-9-month calves with supplements of calcium salts of fatty acids, made on the base of sunflower oil, considerably increases a share of linoleic and linolenic fatty acids in the content of lipids of blood plasma and rises the average daily gain of live weight of calves in contrast to the animals not fed with fatty supplements in their diet.

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COMMON CARP (CYPRINUS CARPIO L.) IN AQUATIC ECOSYSTEMS AND AQUACULTURE

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Formulation of the problem. Common carp (*Cyprinus carpio* L.) – a widely representative of the carp family (Cyprinidae) – largest family of freshwater bony fishes. With the spread of aquatic ecosystems is bentopelahichnyy species belonging to potamodromiv [14]. *C. carpio* usually described as alien species originating from Asia. Type introduced in almost all parts of the world (excluding the Middle East and poles), naturalized in European waters [12]. This type is often considered too invasive that can displace native fish species [14]; it is included in the list of 100 most invasive species in freshwater ecosystems. However, the form of domesticated common carp, which are bred in fishery ponds is one of the most common food fish fishery in temperate regions [12; 13].

Analysis of recent research and publications. The structure type *C. carpio* subspecies are: *Cyprinus carpio carpio* (mirror carp or European) common in water most of Europe (particularly in the basins of the Danube and Volga) and *Cyprinus carpio haematopterus* (Amur carp) – native to Asia [12].

Both subspecies *C. carpio* – European and Asian – has long been domesticated. As a result of domestication and crossbreeding with other related species (eg, *Carassius auratus*), which took place in Europe, China and Japan, there are many species of carp, including a large number of decorative forms [12].

Species pond carp are distinguished by the presence and shape of flake cover: flake (fully covered with scales), mirror (with large mirror scales that run along the back and side lines, bred in Germany), naked or leathery (almost without scales, except for sections near the dorsal fin, tail and gills). Ukraine has taken out two breeds: Ukrainian and Ukrainian scaly carp ramchatyy and 3 types within species: Ukrainian nyvkivskyy scaly, scaly Lyubinskiy Ukrainian and Ukrainian ramchatyy Lyubinskiy [4; 5; 9; 10].

Interbreed type Ukrainian scaly carp species – Ukrainian scaly Lyubinskiy was created during the years 1963 – 1998 reproduced by crossing genotypes of geographically and genetically distant to each other (improved breeding herds and Gorodotsky nsevitskoho flake arrays and ropshynskoho carp) in research farm "Big Lubin" Lviv branch Institute for Fisheries UAAS [6]. This high-performance type of scaly carp resistant rubella, refrigerants and is characterized by increased winter hardiness and is suitable for growing in Western Ukraine.

Setting objectives. The aim of our study was to analyze the biological and ecological features of natural populations of *C. carpio* and their differences from the domesticated carp.

Conclusions. Common carp (*Cyprinus carpio* L.) – widespread species of freshwater fish that inhabits eutrophic water bodies and waterways of Europe and Asia. He is considered one of the indicator species in aquatic ecosystems. However, this type of domesticated long ago and is an important object of aquaculture in the fisheries temperate. Individuals *C. carpio*, who inhabit natural reservoirs are characterized by biological and ecological features compared to the domesticated carp. Natural populations of *C. carpio* have a high capacity to adapt to changes in the conditions of the water environment, but are vulnerable to various types of human impacts on aquatic ecosystems.

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