received data shows the ambiguous influence of the HTC indicator on the accumulation of ascorbic acid in black currant fruits. A comprehensive and comprehensive study of the most complex details of the metabolism of substances showed that ascorbic acid plays one of the crucial roles in the entire cycle of intrauterine development of plants from emergence to disappearance – the role of a direct participant in the process of respiration, photosynthesis, regulation of the activity of enzymes and coenzymes, general metabolism and transport of substances, protecting cells from oxidative stress caused by abiotic factors.

Thus, the high C-vitality of black currant fruit depends to a large extent on the variety, and only then on weather conditions during the formation of the harvest.

Key words: *black currant, variety, quality, chemical composition, ascorbic acid*

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ECONOMIC AND ENERGY EVALUATION OF THE ELEMENTS OF GROWING TECHNOLOGY OF DIFFERENT SPECIES OF SAINFOIN IN THE RIGHT-BANK FOREST-STEPPE

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Наведено результати досліджень, щодо економічної та біоенергетичної оцінки вирощування різних видів еспарцету залежно від удобрення, висоти скошування травостою, інокуляції насіння та років використання. Встановлено, що найвищий умовно чистий прибуток та найнижчу собівартість кормової одиниці та сирого протеїну мали за вирощування еспарцету посівного, економічні показники вирощування еспарцету закавказького та піщаного видів значно поступалися першому. Найвищий коефіцієнт енергетичної ефективності та найменші затрати енергії на вирощування 1 тонни кормових одиниць отримали на посівах еспарцету посівного сорту Аметист Донецький.

Ключові слова: *еспарцет посівний, закавказький, піщаний, удобрення, висота скошування, економіка, біоенергетична оцінка.*

Analysis of recent researches and publications. The highest condition for the accelerated development of livestock production in the country is the creation of a strong fodder base. This directly affects the ability to increase livestock amount and its productivity. The reform of agriculture led to a sharp reduction in sown areas under perennial legumes, which in turn affected the flow of organic matter into the soil. Insufficient application of organic and mineral fertilizers significantly worsens of soil fertility, which negatively affects the level of agricultural crops productivity.

The sowing areas under perennial legumes in farms of some regions of Ukraine decreased by 3–4 times in recent years and were not more than 5 % in the structure of sowing areas [1, 2].

Perennial legumes are of particular importance in circumstances when crop yields are most dependent on climatic conditions. Alfalfa and sainfoin plants compared to the plants of other crops are less affected by air drought and lack of moisture in the upper soil layer due to the strong root system that penetrates deep into the soil [3–5].

Perennial legumes are required growing together with other agricultural crops because of economic instability in the country, as they have significant advantages over cereals and contribute to the restoration of degraded arable land, increasing of soil fertility and reducing of energy consumption [6–8].

Sainfoin is one of the most productive legumes with a high protein content, the green mass of which exceeds both cereals and some perennial legumes by the protein content. Sainfoin is an excellent honey plant, which is easily pollinated by bees and forms a stable seed yield, it does not cause tympany when fed by animals. Hay and green mass of this culture is rich in mineral salts and vitamins, 1 kg of green mass contains 65 mg of carotene, up to 60 g/kg of sugar, up to 228 mg/kg of vitamin C, 106 g of digestible protein. The supply of one fodder unit of digestible protein is 196 g.

From 63.4 to 84.6 kg/ha of nitrogen and 19.7 and 26.1 kg/ha of phosphorus remain in the soil after two years of sainfoin sowing. The total amount of nitrogen accumulated by sainfoin in the soil after three years of use can reach 140–200 kg/ha. Therefore, it serves as a good precursor for all crops.

However, despite the significant advantages of sainfoin, the areas under this crop remain insignificant, especially in the Forest-Steppe zone. One of the reasons for this state is the undeveloped zonal technology of growing of different varieties of sainfoin with their economic and energy evaluation. Currently, many scientists have performed a large number of researches on study the impact of technological measures, including fertilizer levels, on the formation of productivity and quality of obtained fodder by sainfoin and on conducting of economic and energy evaluation. However, there is no consensus on the effect of mineral nitrogen and the height of grass mowing on the growth and development of different types of sainfoin, and therefore this question remains open and needs further study. The above determined the purpose of the research – to study the peculiarities of the formation of yields of different species of sainfoin depending on the elements of the technology of their growing in the Northern part of the Right-Bank Forest-Steppe.

Research methodology. Experimental studies were conducted during 2016–2018 at the research site of the SS of NULES of Ukraine “Agronomic Research Station” located in Pshenychne village of Vasylkiv district of Kyiv region.

Scheme of the experiment:

Factor A. Varieties of sainfoin

1. Common (Ametyst Donetsky variety);
2. Transcaucasian (Adam variety);

3. Hungarian (Smaragd variety).

Factor B. Fertilizers, inoculation

1. Without fertilizers and inoculation;
2. $N_{45}P_{60}K_{90}$ + seeds inoculation with rhizotorphine;
3. $P_{60}K_{90}$ + seeds inoculation with rhizotorphine.

Factor C. The height of grass mowing

1. 5 cm;
2. 10 cm;
3. 15 cm.

Method of sowing — by row, spring coverless. Rhizotorphine was used for inoculation. Repetition — four times, the area of the sown plot — 80 m^2, the accounting area — 50 m^2.

The soil of the experimental field is typical low-humus chernozem, in terms of granulometric composition — coarse-pulverous–and–medium-loamy. The content of humus (according to Tiurin) in the arable layer is 4.4 %, pH of salt extract — 6.8–7.3, light hydrolyzed nitrogen (according to Cornfield) — 106–114 mg/kg, mobile phosphorus (according to Machyhin) — 62–65 mg/kg and metabolic potassium (according to Chyrikov) – 89–106 mg/kg, absorption capacity — 30.7–32.5 mg-eq (100 g of soil); soil density in a balanced state — 1.16–1.25 g/cm^3; humidity of steady withering — 10.8 %. These data suggest that field research was conducted in typical soil-and-climatic conditions for the Northern part of the Right-Bank Forest-Steppe.

Weather conditions in the years of research, in general, were satisfactory for the growth and development of sainfoin, but differed from the average long-term indicators in terms of precipitation and average daily temperatures, according to the weather station iMetos, located on the territory of SS of NULES of Ukraine "Agronomic research station" (Fig. 1, 2).

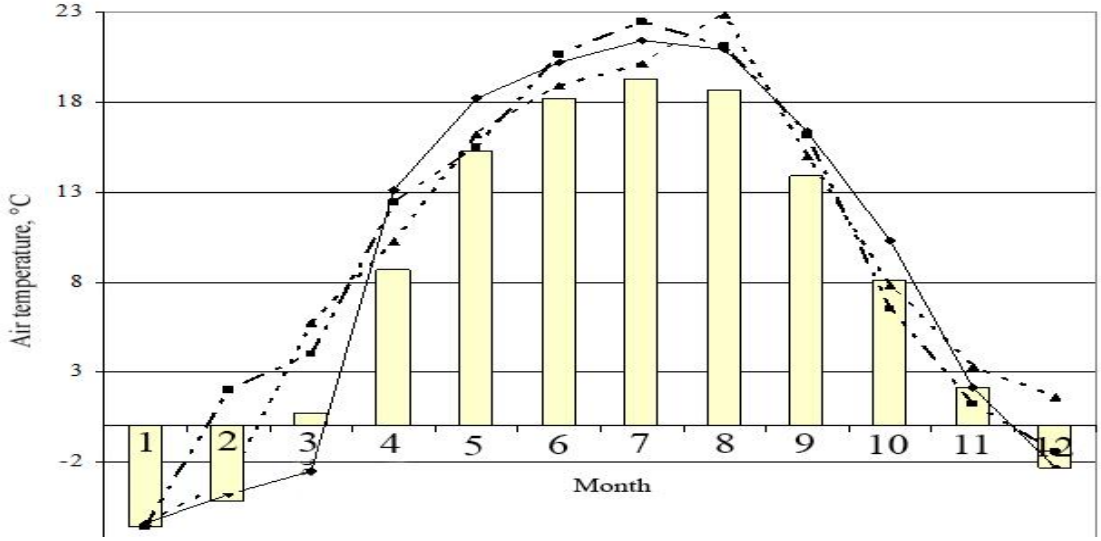

Fig. 1. Distribution of average monthly temperatures, °C (ARS NULES):

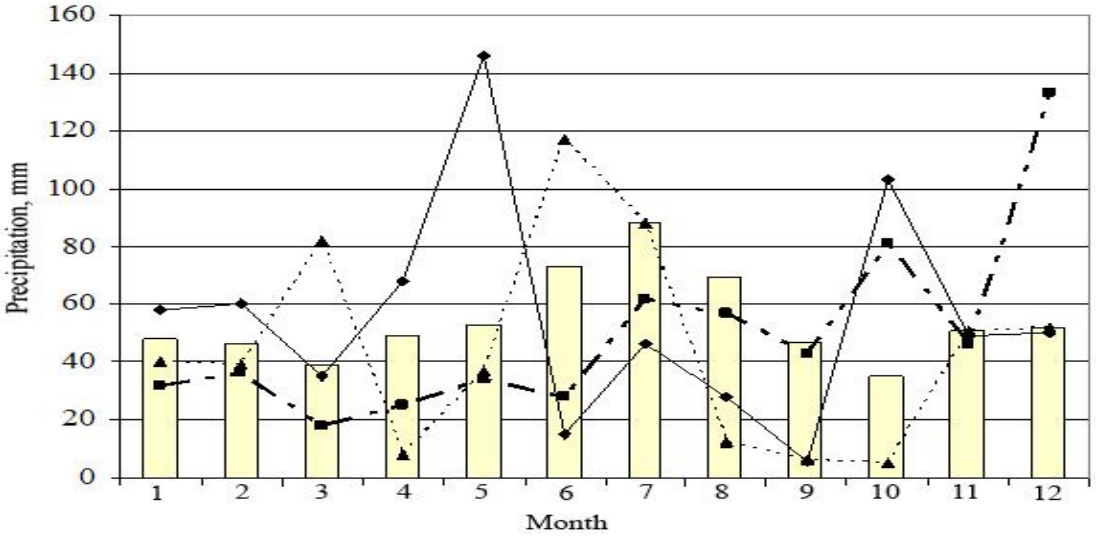

Fig. 2. Distribution of precipitation by months, mm (ARS NULES):

In all years of the study, the vegetation of sainfoin plants, especially in the period of formation of cutting ripeness, occurred against the background of increasing average daily temperatures, often against the background of insufficient supply of sowings with precipitation.

Insufficient moisture supply against the background of high air temperatures created difficult conditions for the growth and development of plants and their yield formation. A significant excess of the average long-term precipitation was observed only in May 2016 (2.8 times) and in March and June 2018, respectively 2.1 and 1.6 times.

Research results. Several methods which differ in the system of indicators and methods of their calculation are used for economic evaluation of fodder crops [7–9]. Some of them allow determining the efficiency of production of certain types of fodders, others — the efficiency of their consumption by animals. The choice of fodder crops should be based on an assessment of their production.

The main indicators for evaluating of the elements of growing technology of fodder crops are: yield, production outlet in fodder units and digestible protein, fodder protein units, dry matter, energy substances from 1 hectare of crops sowing, direct labour costs, production costs per unit of nutrients, value of gross and net income per 1 hectare of sowing. The unit cost of nutrients of fodder crop for determining the value of gross and net income is equalized to the market price of 1 kg of oats. The indicator of net income allows determining the profitability of cultivation of fodder crop for the purposes of sale on the market.

Evaluation of economic efficiency of the technology measures offered to the manufacture demands the complex accounting of agronomic, zootechnical and economic indicators. The combination of yielding capacity of green mass of sainfoin and its protein-enriched with high nutrition is of particular importance.

Economic efficiency significantly depends on the application of mineral fertilizers. It is known that fertilization of fodder crops is a highly effective agrotechnical measure to increase their fodder and protein productivity. However,

recently the use of mineral fertilizers has decreased sharply, especially in the sowings of fodder crops. This is due to the high energy intensity and cost of mineral fertilizers production, environmental problems connected with their production and use. This problem is exacerbated by the inability to pay of farms of various forms of ownership. Therefore, there is a need to optimize the cost of traditional mineral fertilizers and to use biological nitrogen.

Economic evaluation of the results of field experiments and production inspections was carried out in accordance with generally accepted methods developed by the Institute of Grain Management, the Institute of Fodders, the Institute of Agrarian Economics of UAAS and other research institutions [6, 10, 11]. Conditional-and-net profit, the level of profitability and payback of material costs as the main criteria of efficiency in the calculations were taken. Profit of 1 ha was defined as the difference between the cost of obtained products and production expenses. Production expenses and products costs were calculated according to the norms and prices used in the Forest-Steppe zone [6, 9].

The calculations of monetary-and-material expenses were performed taking into account the full mechanization of works according to the economic evaluation. The expenses for them were calculated according to the technological charts developed in the process of research. The cost of seeds, fertilizers and fuel was taken at wholesale prices as of January 1, 2019, 1 ton of fodder units of meadow grass was equated to the cost of 1 ton of forage grain.

The results of conducted economic research indicate the same expenses when setting up an experiment with different types and varieties of sainfoin, both with and without mineral fertilizers application (Table 1). However, economic indicators differed significantly at the end of the growing season after harvest, because the productivity of different types of sainfoin changed significantly not only due to the biological characteristics of the species and variety of sainfoin, but also by their different reactions to applied mineral fertilizers.

The application of mineral fertilizers had a significant impact on economic indicators. The highest profitability of sainfoin growing was obtained at common sainfoin without fertilizers (179 %), which was higher in absolute terms by 47 % than the application of $P_{60}K_{90}$ and 3.9 % — under the application of $N_{45}P_{60}K_{90}$. Such dependence was observed in the prime cost of grown products. The lowest prime cost of 1 ton of fodder units — 1431 UAH and 1 ton of crude protein — 7291 UAH was observed at the sowings of common sainfoin in unfertilized areas. A similar dependence on the application of mineral fertilizers was observed at the sowings of Transcaucasian and Hungarian species and varieties.

Energy evaluation of formation of sown grass stands of different types of sainfoin showed that increasing the amount of fodders production and livestock products is possible under the widespread introduction of energy and resource-saving technologies in agricultural production, using non-traditional and constantly renewable energy sources, which reduce its costs for the production of certain products due to the limited use of traditional non-renewable energy sources in modern conditions.

1. Economic indicators of different types of sainfoin growing for fodder depending on mineral fertilizer and seeds treatment with rhizotorphine, the average for 2016–2018

Species and variety of sainfoin	Fertilization variant	Yield of dry mass, t/ha	Cost of grown products, UAH/ha	Growing costs, UAH/ha	Conditionally net profit, UAH/ha	Profitability, %	The prime cost of 1 ton	
							of fodder unit of crude	protein, UAH
Common, Ametyst Donetsky variety	without fertilizers	6.98	20940	7586	13354	176	1431	7291
	$N_{45}P_{60}K_{90}$ + inoculation	9.53	28590	12086	16504	137	1627	8393
	$P_{60}K_{90}$ + inoculation	8.37	25110	10980	14130	129	1705	8855
Transcaucasian, Adam variety	without fertilizers	6.07	183210	7586	10624	140	1646	8157
	$N_{45}P_{60}K_{90}$ + inoculation	8.29	24870	12086	12784	106	1845	9087
	$P_{60}K_{90}$ + inoculation	7.46	22380	10980	11400	104	1890	9385
Hungarian, Smaragd variety	without fertilizers	5.54	16620	7586	9834	119	1887	8821
	$N_{45}P_{60}K_{90}$ + inoculation	7.87	23610	12086	11524	95	1943	9442
	$P_{60}K_{90}$ + inoculation	6.85	20550	10980	9570	87	2056	9982

The energy consumption for any crop growing should be several times less than its content in the yield. However, it may be that the energy consumption for the technology exceeds the energy collection from 1 ha in the grown products. This is due to the low crop yields or irrational use of available material resources.

Fodders in the structure of expenses for the production of livestock products depending on its type are from 50 to 80 %. Any type of fodder is a source of energy obtained through both photosynthesis and total energy expenses for its production. The effect of changing of the latter type of energy into the energy of livestock products serves as a criterion for the evaluation of the energy saving balance. Therefore, it is no coincidence that a criterion of the evaluation of energy balance should be along with the criterion of economic evaluation of any technological process in agricultural production [9, 10].

The most important criterion for the evaluation of the efficiency level of technological measures of the formation and use of grass stands on hayfields is not the amount of consumed energy, but the energy capacity of the products caused by its expenses for 1 ton of fodder units, as well as energy coefficient (EC) and coefficient of energy efficiency (CEE). The energy coefficient was determined by dividing the gross energy by the total expenses and the coefficient of energy efficiency — by dividing the exchange energy by the total energy expenses [9]. Calculations in energy analysis are performed in a single international unit — joules [10].

According to the performed calculations, the above indicators of energy efficiency depended on the species composition of sainfoin, fertilizer application and seeds inoculation (Table 2). As it was established, the output of gross energy, energy coefficient and coefficient of energy efficiency at the same energy consumption of 10.7 GJ/ha on the sowings without fertilizers were the highest at common sainfoin and reached 117, 10.9 and 6.3, respectively. The indicators were also the highest under the introduction of $P_{60}K_{90}$, but with higher values — 141, 10.4 and 5.6 than the energy indicators on the sowings of Transcaucasian and Hungarian sainfoin.

The application of phosphorus-and-potassium fertilizers and against their background the application of mineral nitrogen fertilizers serves an important measure in the technology of sainfoin growing. The application of phosphorus-and-potassium fertilizers at a dose of $P_{60}K_{90}$ provides an improvement in all energy indicators according to the performed analysis of the obtained data. Application of fertilizers provided the increase in gross energy by 21 %, the output of exchange energy by 20.9% at the sowings of Common sainfoin compared to the unfertilized sowings; the same dependence in the Transcaucasian and Hungarian species was observed with the following indicators, respectively — 25 and 24 % and in Hungarian — 27 and 27 % compared to the sowings without fertilizers. The application of additional nitrogen fertilizers significantly worsened the energy indicators, although the application had a positive effect on the obtaining of a conditionally net profit. The most important criterion for evaluation of the efficiency level of technological measures for the formation and use of hayfields is not the amount of energy consumed, but the energy capacity of products, as well as the coefficient of energy efficiency.

2. Indicators of energy evaluation of grass stands forming of different types of sainfoin depending on fertilizer

Species and variety of sainfoin	Fertilization variant	Total energy consumption, GJ/ha	Output of gross energy, GJ/ha	Output of exchange energy of harvest, GJ/ha	Energy coefficient (EC)	Coefficient of energy efficiency (CEE)	Energy capacity of 1 fodder unit, GJ
Common, Ametyst Donetsky variety	without fertilizers	10,7	117	67	10,9	6,3	0,21
	$N_{45}P_{60}K_{90}$ + inoculation	19,8	158	91	7,8	4,6	0,27
	$P_{60}K_{90}$ + inoculation	13,6	141	81	10,4	5,6	0,21
Transcaucasian, Adam variety	without fertilizers	10,7	99	57	9,3	5,3	0,23
	$N_{45}P_{60}K_{90}$ + inoculation	19,8	138	79	6,9	4,0	0,30
	$P_{60}K_{90}$ + inoculation	13,6	124	71	9,1	5,2	0,23
Hungarian, Smaragd variety	without fertilizers	10,7	89	51	8,3	4,8	0,25
	$N_{45}P_{60}K_{90}$ + inoculation	19,8	130	75	6,5	3,8	0,32
	$P_{60}K_{90}$ + inoculation	13,6	113	65	8,3	4,8	0,25

The highest indicators of CEE (4.6–6.3) and the least energy-intensive (0.21) were found in the fodder obtained at the sowings of Common sainfoin under the application of only phosphorus-and-potassium fertilizers and without mineral fertilizers at all.

Conclusions. 1. The highest conditionally net profit (13.35 thousand UAH from 1 ha, the level of profitability (129–176%) and the lowest prime cost of fodder unit (1431–1627 UAH for 1 ton) and crude protein (8.4–7.3 thousand UAH/t) was obtained at Common sainfoin (Ametyst Donetsky variety); economic indicators of sainfoin growing of Transcaucasian and Hungarian species were much lower than the first.

2. The highest energy coefficient of energy efficiency, as well as the lowest energy consumption for the production of 1 ton of fodder units was determined at the sowings of Common sainfoin of Ametyst Donetsky variety.

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Аннотация

Демидась Г. І., Лихошерст Е. С., Полторецька Н. М.

Економічна та енергетична оцінка елементів технології вирощування різних видів еспарцету в Правобережному Лісостепу

Приведены результаты исследований, по экономической и биоэнергетической оценке выращивания различных видов эспарцета в зависимости от удобрения, высоты скашивания травостоя, инокуляции семян и лет использования. Одной из самих распрастранненных бобовых культур, обладающих высоким содержанием протеина, является эспарцет, зеленая масса которого превышает по содержанию белка как злаковые так и некоторые многолетние бобовые травы. Однако, несмотря на значительные преимущества эспарцета под его посевами остаются еще незначительными особенно в зоне Лесостепи. Одной из причин этого является неотработанная

зональная технология выращивания различных видов эспарцета с их экономической и энергетической оценкой. Методика исследований. Экспериментальные исследования проводили в течение 2016-2018 гг. На опытном участке ОП НУБиП Украины «Агрономическая опытная станция», которая расположена в с. Пшеничная, Васильковского района Киевской области. ***Схема опыта****: Фактор А. Виды эспарцета (Посевной (сорт Аметист Донецкий) Закавказский (сорт Адам) Песчаный (сорт Изумруд). Фактор Б. Удобрения, инокуляция (без удобрений и инокуляции; N45P60K90 + инокуляция семян ризоторфином; P60K90 + инокуляция семян ризоторфином). Фактор В. Высота скашивания травостоя (5, 10, 15 см). Способ сева — строчный, весенний безпокровных. Для инокуляции использовали ризоторфин.* ***Выводы.*** *Установлено, что высокий условно чистая прибыль и низкую себестоимость кормовой единицы и сырого протеина имели выращивания эспарцета посевного, экономические показатели выращивания эспарцета закавказского и песчаного видов значительно уступали первому. Самый высокий коэффициент энергетической эффективности и маленькие затраты энергии на выращивание 1 тонны кормовых единиц получили на посевах эспарцета посевного сорта Аметист Донецкий.*

Ключові слова: *еспарцет посівний, закавказький, піщаний, удобрення, висота скошування, економіка, біоенергетична оцінка.*

Annotation

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Economic and energy evaluation of the elements of growing technology of different species of sainfoin in the Right-bank Forest-steppe

The results of the research on economic and bioenergetic evaluation of different types of sainfoin growing depending on fertilizer, grass mowing height, seed inoculation and years of use were presented. Sainfoin is one of the most productive legumes with a high protein content, the green mass of which exceeds both cereals and some perennial legumes by the protein content. However, despite the significant advantages of sainfoin, the areas under this crop remain insignificant, especially in the Forest-Steppe zone. One of the reasons for this state is the undeveloped zonal technology of growing of different varieties of sainfoin with their economic and energy evaluation. ***Research methodology.*** *Experimental studies were conducted during 2016–2018 at the research site of the SS of NULES of Ukraine "Agronomic Research Station" located in Pshenychne village of Vasylkiv district of Kyiv region. Scheme of the experiment: Factor A. Varieties of sainfoin (Common (Ametyst Donetsky variety); Transcaucasian (Adam variety); Hungarian (Smaragd variety). Factor B. Fertilizers, inoculation (without fertilizers and inoculation; $N_{45}P_{60}K_{90}$ + seeds inoculation with rhizotorphine; $P_{60}K_{90}$ + seeds inoculation with rhizotorphine). Factor C. The height of grass mowing (5, 10, 15 cm). Method of sowing – by row, spring coverless. Rhizotorphine was used for inoculation.* ***Conclusions****. It was found that the highest conditionally net profit and the lowest prime cost of fodder unit and*

crude protein were obtained under common sainfoin growing, economic indicators of growing of Transcaucasian sainfoin and Hungarian sainfoin were much lower than the aforementioned. The highest energy efficiency coefficient and the lowest energy costs for growing of 1 ton of fodder units were obtained on the sowings of common sainfoin of Ametyst Donetsky variety.

Keywords: *common sainfoin, Transcaucasian, Hungarian, fertilizer, mowing height, economy, bioenergy evaluation.*

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ІСТОРИЧНІ АСПЕКТИ, МОРФОЛОГО-БІОЛОГІЧНІ ТА АГРОТЕХНОЛОГІЧНІ ОСОБЛИВОСТІ ВИРОЩУВАННЯ СОРТІВ ТЮЛЬПАНІВ (*TULIPA* L.) З МЕТОЮ ПОДАЛЬШОГО ВИКОРИСТАННЯ В ОЗЕЛЕНЕННІ

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Здійснено оцінювання 50 інтродукованих генотипів тюльпана (TULIPA L.*) в умовах Правобережного Лісостепу України, а саме: кафедрою садово-паркового господарства Уманського НУС за групами, класами, де представлено різні сорти, в основному іноземної селекції, за декоративними властивостями та основними господарсько-біологічними ознаками та згруповано у колекцію. Проведено та узагальнено показники стосовно фенологічних фаз розвитку інтродукованих рослин у розрізі окремих сортів тюльпанів та в середньому за роками досліджень. Наведено коротку агробіологічну та декоративну характеристику колекційних сортозразків в умовах Правобережного Лісостепу України, які включено в подальші дослідження щодо вирощування та розмноження перспективних сортів. Проведено польові спостереження на стійкість різних сортів тюльпану до сірої гнилі в умовах Лісостепу України і виокремлено, що ураженість досліджуваних генотипів була на низькому і дуже низькому рівні, не зважаючи на контрастні умови різних років дослідження.*

Ключові слова*:тюльпани, генотип, декоративні властивості, дослідження, інтродукція, хвороби.*

Постановка проблеми. Тюльпан (*Tulipa* L.) — має близько 140 видів, які вирощувались у давні часи у Середній Азії. Перші відомості про тюльпани зустрічаються в Персії. Слід зазначити, що у таджиків, мова яких належить до іранської групи мов, існує щорічне свято тюльпанів — Сайри лола. Нині важко дослідити, які саме види стали предками перших окультурених рослин, однак,