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Agroecological Assessment of Soybean Varieties under the Conditions of the Right Bank Forest Steppe of Ukraine

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ABSTRACT

Agroecological testing of soybean varieties of domestic and foreign selection was carried out during 2020-2022 on the experimental field Institute of Feed Research and Agriculture of Podillya of NAAS, which is located in the zone of the right-bank forest-steppe of Ukraine. The subject of research was domestic soybean varieties (Diadema Podillia, Tytan, Kobuko, Monada, Triada (Institute of Feed Research and Agriculture of Podillya of NAAS); Vorskla, Lehenda (National Research Center "Institute of Agriculture of the National Academy of Sciences") and foreign (Merlin, Kardiff, Kent, Padua (SAATBAU LINZ eGen); Kioto, Kordoba, Briunensis (Semences Prograin Ink.); Senator, Alihator (Euralis Semences); Sultana (RAGT Semences) selection. All soybean varieties studied during 2020–2022 were entered into the State Register of plant varieties suitable for distribution in Ukraine. The maximum seed yield in the zone of the right-bank forest-steppe of Ukraine was recorded in the following varieties: Triada (3.41 t/ha), Kioto (3.29 t/ha), Alihator (3.25 t/ha), Kobuko (3.19 t/ha), Monada (3.15 t/ha), Kardiff (3.06 t/ha) and Tytan (3.05 t/ha). According to the results of the analysis of the mass of 1000 seeds, its highest indicators were noted in soybean varieties: Tytan – 194 g, Alihator – 192 g, Kent –193 g, Sultana – 200 g. According to the results of the biochemical analysis of soybean seeds, it was found that most of the studied varieties provided the content crude protein is more than 40%, while the Merlin, Alihator, Triada, Cardiff and Kent varieties had a crude protein content of 37.1-39.1%. The obtained results of the content of amino acids in soybean seeds show more noticeable indicators in the Tytan soybean variety. Thus, on the basis of a comprehensive approach to soybean productivity indicators, such varieties of domestic selection as Tytan and Kobuko, as well as foreign selection of Kioto, are recommended for agricultural production in the areas of seed production, animal feed and raw material in the selection process.

Keywords: variety, productivity, plasticity, stability, weight of 1000 seeds, crude protein, amino acid composition.

INTRODUCTION

The variety is the basis of soybean cultivation technology, it is not only a means of increasing productivity, but also a factor without which it is impossible to realize the accumulated genetic potential (Hetman et al., 2024; Mazur et al., 2019). The variety determines the yield level of the crop, the quality of the seeds and is the most accessible means of increasing the yield of agricultural crops (Bakhmat et al., 2021; Mazur et al., 2021 a). Ukrainian breeders have created new soybean varieties with a productivity level of 3.5–4.5 t/ha on non-irrigated land, 4.0–5.5 t/ha under irrigated conditions and a crude protein yield of 1.2–1.4 t/ha ha (Petrychenko et al., 2013; Bondarenko et al., 2022). The realization of the genetic potential of such varieties requires the development and application of modern cultivation technologies (Petrychenko et al., 2014; Tkachuk et al., 2024).

The introduction and distribution of varieties depends significantly on their biological characteristics and environmental conditions. To realize the biological and genetic productivity potential, each variety needs to be grown in the appropriate region or belt (Hnatiuk et. al., 2019). Taking into account the requirements for soybean cultivation conditions, soil and hydrothermal resources of Ukraine, the scientists of the Institute of Fodder and Agriculture of the Podillia National

Academy of Sciences identified a "soy belt", where 2/3 of soybean crops are located, a zone of sustainable and unstable production of this crop on rainfed lands and a zone of guaranteed soybean production on irrigated lands (Petrychenko et al., 2012; Mazur et al., 2021 b).

In the soybean belt of Ukraine, it would be possible to grow about 3 million hectares of soybeans, it includes regions with a vegetation period of 100–140 days, where the sum of active temperatures is 1800–3000°C, 500-600 mm of precipitation or more falls per year, which is sufficient for growing soybean varieties (Petrychenko et al., 2014).

Climate change and the creation of new high-yielding precocious varieties in recent years by the Institute of Fodder and Agriculture of the Podillia Branch of the National Academy of Sciences of Ukraine, together with other research institutions, contributed to the expansion of the soybean belt to the north of the Forest Steppe and to the south of the Polissia of Ukraine (Petrychenko et. al., 2018). Figure 1 shows the distribution of soybean crops by soil and climate zones of Ukraine.

In Ukraine, soybean crops are mainly concentrated in the forest-steppe and steppe zones; however, during the period from 2012 to 2022, their area decreased from 64 to 57% and from 24 to 13%, respectively, while in the Polissia zone, on the contrary, it increased from 12 to 30% (2.5 times). This indicates that there are a sufficient number of soybean varieties of the ultra-early, early- and mid-early ripening groups on the market of Ukraine, which are guaranteed to ripen and form a crop in the conditions of Polissia.

Today, more than 1,000 varieties of soybeans are known, which are characterized by high productivity. The total number of registered soybean varieties in Ukraine in 2012 was 125%, 29% of them were of foreign selection, and 71% were domestic. In more than 10 years, the situation has changed dramatically: 332 soybean varieties have been entered into the State Register of plant varieties suitable for distribution in Ukraine, of which 61% are foreign, 39% are domestic (Table 1).

Soybean varietal resources are updated every year and the share of foreign breeding varieties increases. The reason for the decrease in the share of varieties of traditional selection is the addition to the Law of Ukraine No. 2245-VIII of December 21st, 2017, according to which from September 1st, 2018 to December 31st, 2021, the budget VAT

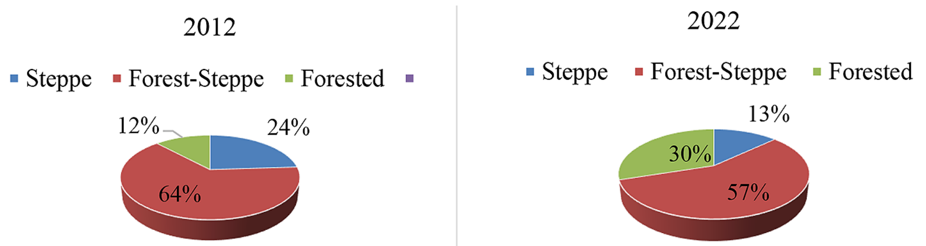

Figure 1. Dynamics of the structure of soybean sowing areas in the soil and climatic zones of Ukraine, %

Table 1. The structure of soybean varieties in Ukraine

Years	Domestic selection		Foreign selection	
	piece	%	piece	%
2012	89	71	36	29
2013	100	72	39	28
2014	101	67	50	33
2016	112	59	79	41
2017	125	59	85	41
2018	123	61	79	39
2019	122	55	101	45
2020	123	50	124	50
2021	123	43	163	57
2022	108	39	169	61
June 2024	130	39	202	61

refund for the export of soybeans is canceled (Mazur et al., 2022). As a result, the demand for varieties of national selection decreased, which negatively affected the effectiveness of the national seed production system. When analyzing varietal resources by novelty, it was found that the largest number of 57% of soybean varieties were registered and entered into the State Register of plant varieties suitable for distribution in Ukraine five years or less ago, 25% – 6–10 years and 18% – more than 10 years (Fig. 2).

The main domestic applicants of soybean varieties in the State Register of Plant Varieties suitable for distribution in Ukraine are: NSC Institute of Agriculture of the National Academy of Sciences of Ukraine, Institute of Fodder and Agriculture of the Podillia Branch of the National Academy of Sciences of Ukraine, Institute of Irrigated Agriculture of the National Academy of Sciences of Ukraine, Institute of Oil Crops of the National Academy of Sciences of Ukraine, Bukovynsky Institute of APV, Kirovohrad Institute of APV, NSNF "Soybean Age", Breeding and Genetics Institute of the National Academy of Sciences of Ukraine, Plant Breeding Institute named after V.Ya. Yuryeva of the National Academy of Sciences of Ukraine (Babich et al., 1998).

Competition in the soybean seed production segment consists of foreign Canadian companies: Semences Prograin Inc., Sevita Genetics; France: Evralis Semens, Kossad Semens, RAZHT 2n, Serbia: Delta Agrar d.o.o.; Austria: Zaatbau Linz reg. Gene. m.b.H, Probstdorfer Zaatzucht Gez.m.b.H. and CoKG; Germany: Deutsche Zaatferedelung AG, Zaaten-Union GmbH (Zhou, et. al., 2019).

It should be noted that the seed yield potential of both domestic and foreign soybean varieties is quite high: ultra-early ripening – 2.3–2.8 t/ha, early ripening – 2.5–3.0 t/ha, medium-early ripening – 3.0–4.0, medium-ripe – 4.1–5.0 t/ha and more (Petrychenko, et. al., 2024). However, it has been proven that the maximum productivity and stability of agrophytocenosis are incompatible due to the impossibility of combining all constituent components into one system. The optimality of these understandings in the system, to a certain extent, is possible due to the process of adaptability to the environmental conditions of a specific region – plasticity (Patyka et. al., 2004). A high index of plasticity characterizes the optimal reaction of plants to the heterogeneity of the environment. As a result of the analysis of ecological plasticity and stability, it is possible to find out not only the various norms of reaction to growing conditions, but also to identify the genotypes that will be able to implement productivity in the face of significant changes in environmental factors and ensure the most effective use and distribution of them (Alpert et al., 2002; Callahan, et al., Pantsyreva et al., 2023; Petrychenko et al., 2018).

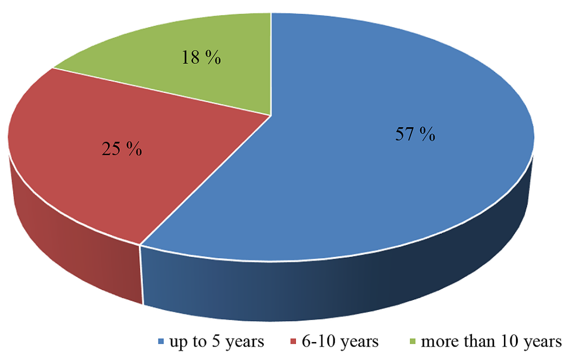

Figure 2. Analysis of soybean varietal resources by novelty, 2022

Studies conducted in different soil and climatic zones of Ukraine (Right-bank and left-bank forest steppe) showed that Kioto and Kassidy soybean varieties are highly plastic and stable in terms of seed yield, weight of 1000 seeds, protein content and collection (Prysiazhnyuk et al., 2005). Assessment of plasticity and stability of soybean varieties, selections of the Institute of Plant Breeding Yuryev and the Institute of Fodder and Agriculture of the Podillia National Academy of Ukraine showed that Malvina, Estafeta, Sprytna, Krynytsia and Baika, Omega Vinnytska, Zolotista, Vinny, Millennium, KiVin, Themis, Millennium, Triada, Smolyanka, Anatoliivka varieties in terms of seed yield potential meet the modern requirements of agro-industrial production, have high ecological plasticity and provide a small amplitude of phenotypic variability and, thereby, the stability of the realization of the genetic potential of productivity (Chernyshenko, et al., 2014; Tsytsiura, et al., 2021; Puyu, et al., 2021, Petrychenko, et al., 2018).

Under the conditions of the Ivano-Frankivsk region of Ukraine, by determining the stability and plasticity of soybean varieties, intensive type varieties were selected, such as Kuban, Vidra, Biser, which can be recommended for cultivation in the western part of the forest-steppe of Ukraine, but under the conditions of using intensive cultivation technologies, while Cassidy varieties and ES Mentor is grown under the conditions of a low level of agricultural technology (Dymytrov et. al., 2021).

Almost half of the success in growing soybeans depends on the correct selection of its variety. The emergence of new high-yielding varieties of soybeans allowed not only expanding the area of cultivation of the crop, but also obtaining a high yield of seeds. The introduction and distribution of varieties depends significantly on their biological characteristics and environmental conditions. Therefore, each variety should be grown in that region or zone where the highest realization of the biological and genetic potential of its productivity is manifested. Therefore, the purpose of the research was to conduct an agroecological assessment of soybean varieties according to economic and valuable characteristics and to establish the stability of the manifestation of these characteristics under the conditions of the forest-steppe of the Right Bank of Ukraine.

MATERIAL AND METHODS

The agroecological assessment of soybean varieties of domestic and foreign selection was carried out during 2020–2022 at the experimental field of the Podillia Institute of Forage and Agriculture of the National Academy of Sciences, which is located in the right-bank forest-steppe zone of Ukraine. The soil of the experimental plots is gray forest medium loam in the loess, which was characterized by an average content of humus of 1.96% in the arable layer of the soil, a slightly acidic pH of the soil solution (salt) 5.1–5.8, hydrolytic acidity in the range of 1.86–2,16 mg - equiv/100 g of soil. The degree of saturation with bases was 75–80%, the amount of absorbed bases was 18.8–30.1 mg-eq/100 g of soil. The density of the soil is 1.32 g/cm^3.

The subjects of research were domestic (Diadema Podillia, Tytan, Kobuko, Monada, Triada (Institute of Fodder and Agriculture, Podillia National Academy of Sciences of the National Academy of Sciences), Vorskla, Lehenda (National Research Center «Institute of Agriculture, National Academy of Sciences of the National Academy of Sciences») and foreign (Merlin, Cardiff, Kent, Padua) soybean varieties (SAATBAU Linz), Kioto, Briunensis (Semences Prograin), Sultana (RAGT Semences).

- accounting for the productivity of soybean seeds was carried out by the method of continuous harvesting with a combine harvester and weighing from each plot, followed by the selection of seed samples for laboratory determination of humidity and clogging (Moiseichenko, et al., 1994).
- the mass of 1000 seeds was determined according to DSTU 2949–94: two repetitions of 500 seeds, calculating the arithmetic mean of the mass of both repetitions and the actual difference between the repetitions, which should not exceed 3% of the arithmetic mean (DSTU 2949-94).
- determination of total nitrogen and crude protein was carried out by the Kjeldahl method (DSTU ISO 5983:2003).
- - determination of amino acids in soybean seeds was carried out on an amino acid analyzer AAA-500.
- calculation of indicators of ecological plasticity and stability was carried out according to the method of S.A. Eberhart and B.A. Rusell, who predicted dividing the sum of squares of the interaction of each variety with environmental conditions into two parts
- the linear component of the regression (bi) and the non-linear part, which is determined by the mean squared deviation from the regression line ($S_i d^2$).
- the first shows the degree of reaction of the genotype to a change under the conditions of the growing environment and takes values greater than and less than one, and can also be equal to one.
- the higher the value of the linear regression coefficient, the more demanding the variety is to a high level of agricultural technology, and only in the case of using intensive cultivation technologies will it give maximum returns.

In the case when the coefficient of linear regression is less than one, the variety reacts more weakly to changes in environmental conditions than, on average, the entire set of varieties under study. It is better to use such varieties under the conditions of low agricultural technology, as they will give the maximum return with minimum costs. Provided that the coefficient of linear regression is equal to one, there is a complete correspondence between the change in the yield of the variety and the change in growing conditions. The mean square deviation characterizes the stability of the variety under various environmental conditions. The smaller the square deviation of the actual indicators from the theoretically expected, the more stable the variety (Eberhart et. al., 1966).

RESULTS AND DISCUSSION

Yield is the most important comprehensive indicator of economic value of soybeans, which combines individual plant productivity, biocenosis factor and environmental conditions. Therefore, only with an optimal combination of these factors, can high productivity of culture be expected, which is the resulting feature of factorial action of systems of potential productivity and ecological plasticity and stability (Petrychenko et. al., 2000).

A comprehensive analysis of indicators of plasticity and stability of seed yield of soybean varieties studied allows identifying intensive type varieties that form their productivity depending on the intensification of technology and extensive varieties – which do not reduce productivity under the influence of adverse growing conditions. Therefore, the latter can be recommended for cultivation not only under adverse conditions, but also when using low-cost cultivation technologies.

On average, over three years of research, the seed yield of soybean varieties of the mid-early ripening group ranged from 2.58 t/ha to 3.29 t/ha, and of the medium-ripening variety – from 2.53 to 3.41 t/ha. It should be noted that under the conditions of the right-bank forest-steppe, medium-ripening soybean varieties had an advantage (0.11 t/ha) over varieties of the medium-early ripening group in terms of seed yield (Table 2).

Tytan (3.05 t/ha), Kioto (3.29 t/ha), Alihator (3.25 t/ha) provided the highest level of seed yield (more than 3.0 t/ha) in the group of mid-early maturing varieties. At the same time, these varieties, with a fairly high seed yield, also had high plasticity with a regression coefficient value from 1.3 to 1.5, that is, these varieties manifest themselves as intensive in terms of productivity. It should be noted that this group of maturity, extensive varieties, such as do not reduce their productivity under the influence of abiotic, biotic and anthropogenic factors, was not found.

In the group of medium-ripening varieties, the highest seed yield was provided by soybean varieties Monada (3.15 t/ha), Triada (3.41 t/ha), Kobuko (3.19 t/ha), Kardiff (3.06 t/ha) with with a regression coefficient of 1.3, while Triada and Kobuko varieties with a yield of more than 3.0 t/ha had low plasticity with a regression coefficient

Table 2. Characteristics of soybean varieties by seed yield in the conditions of the right-bank forest-steppe, t/ha (on average for 2020–2022)

No.	Varieties	Applicant country	Ripeness group	Yield, t/ha	Regression coefficient (plasticity), b_i	Root mean square deviation (stability), $S_i d^2$
1	Diadema Podillia	Ukraine	0	2.95	1.3	0.2
2	Tytan	Ukraine	0	3.05	1.3	0.3
3	Merlin	Austria	0	2.79	1.2	0.1
4	Kioto	Canada	0	3.29	1.4	0.1
5	Vorskla	Ukraine	0	2.66	1.4	0.1
6	Lehenda	Ukraine	0	2.62	1.1	0.1
7	Kordoba	Canada	0	2.62	1.4	0.1
8	Briunensis	Canada	0	2.79	1.1	0.1
9	Senator	France	0	2.58	1.1	0.1
10	Alihator	France	0	3.25	1.5	0.2
11	Monada	Ukraine	I	3.15	1.3	0.1
12	Triada	Ukraine	I	3.41	0.7	0.1
13	Kobuko	Ukraine	I	3.19	0.8	0.1
14	Kardiff	Austria	I	3.06	1.3	0.1
15	Kent	Austria	I	2.53	1.1	1.0
16	Padua	Austria	I	2.78	1.3	0.2
17	Sultana	France	I	2.71	1.2	0.1

Note: LSD_{05}, t/ha 0,1393.

value of 0.7 and 0.8, respectively. According to the calculated data of the linear regression coefficient, which was less than one, the variety reacts more weakly to changes in environmental conditions than, on average, the entire set of studied varieties. Such varieties as Triada and Kobuko are better to use under the conditions of low agricultural technology, as they will give the maximum return at low costs. In addition, in other varieties of this ripeness group, such as Kent, Padua, Sultana, at a seed yield level of less than 3.0 t/ha, respectively 2.53 t/ha, 2.78 t/ha, 2.71 t/ha, a high regression coefficient of 1.1 was noted 1.3, 1.2, which indicates their high plasticity.

The mean square deviation characterizes the stability of the variety under various environmental conditions (Honcharuk, et. al., 2022; Petrichenko, et al., 2014).). The smaller the square deviation of the actual indicators from the theoretically expected ones, the more stable the grade. Thus, the smallest square deviation (0.1) in the medium-early ripening group is characteristic of soybean varieties Merlin, Kioto, Vorskla, Lehenda, Kordoba, Briunensis, Senator, while this indicator was 0.2, respectively, for Diadema Podillia, Tytan and Alihator varieties – 0.3, 0.2. In the medium-ripe varieties Monada, Triada, Kobuko, Kardiff and Sultana, the standard deviation was 0.1, and in the varieties Kent and Padua 1.0 and 0.2.

The weight of 1000 seeds, on average for 2020–2022, in the investigated soybean varieties was within 164–200 g (Table 3). According to the weight of 1000 seeds, the varieties are divided into two groups. These are groups with an average weight of 1000 seeds (164–179 g) and high (180–200 g). The following medium-early ripe soybean varieties were characterized by a high weight of 1000 seeds: Tytan – 194 g, Merlin – 180 g, Kioto – 183 g, Alihator – 192 g; in the medium-ripening group – Kobuko 187 g, Kent – 193 g, Sultana – 200 g. The results of the analysis of the weight of 1000 seeds indicate the ability of a larger number of soybean varieties to form an average weight of up to 180 g.

Analysis of the plasticity of the weight of 1000 soybean seeds showed that the regression coefficient is equal to 1.0 in almost all the studied varieties. This indicates that there is a complete correspondence between the change in the mass of 1000 seeds of the variety and the change in growing conditions. In Tytan and Kobuko varieties, the regression coefficient is equal to 0.9. This shows that the weight of 1000 seeds of these varieties is within the average group values.

Soy has a unique chemical composition. Its grain contains 35–50% of protein, which is

Table 3. Characteristics of soybean varieties by weight of 1,000 seeds in the conditions of the Right Bank Forest Steppe, g (on average for 2020–2022)

No.	Varieties	Applicant country	Ripeness group	Weight of 1000 seeds, g	Regression coefficient (plasticity) b_i
1	Diadema Podillia	Ukraine	0	175± 2.0	1.0
2	Tytan	Ukraine	0	194± 3.5	0.9
3	Merlin	Austria	0	180± 1.0	1.0
4	Kioto	Canada	0	183± 8.5	1.0
5	Vorskla	Ukraine	0	168± 2.0	1.0
6	Lehenda	Ukraine	0	170± 3.5	1.0
7	Kordoba	Canada	0	177± 2.0	1.0
8	Briunensis	Canada	0	164± 8.0	1.0
9	Senator	France	0	179±5.0	1.0
10	Alihator	France	0	192±3.5	1.0
11	Monada	Ukraine	I	171±1.0	1.0
12	Triada	Ukraine	I	179±8.5	1.0
13	Kobuko	Ukraine	I	187±10.5	0.9
14	Kardiff	Austria	I	170±5.0	1.0
15	Kent	Austria	I	193±20.0	1.0
16	Padua	Austria	I	165±2.5	1.0
17	Sultana	France	I	200±2.5	1.0

Note: LSD_{05}, g 8,286.

88–95% represented by the water-soluble fraction, including easily soluble globulins (60–81%), albumins (8–25%) and poorly soluble globulins (3–7%). Protein quality is determined by two factors: digestibility and a set of essential amino acids. It contains 10 replaceable and 8 essential amino acids and is almost identical in quality to animal protein, while it is easily absorbed by 70–98%. According to the UN FAO, soy protein is accepted as the standard of vegetable proteins (Petrychenko, et al., 2016; Dubik, et al., 2024; Petrichenko, et al., 2012).

According to the results of the research, it was noted that in all varieties that were studied, the content of crude protein in the seeds was at a fairly high level from 37.1 to 42.6%, which corresponds to the norms of DSTU 4230:2003 for the production of soybean meal of appropriate quality (DSTU 4230:2003). The following soybean varieties of foreign selection with a high content of crude protein in the seeds were identified: Senator (42.4%) and Kioto (42.3%). Diadema Podillia (41.7%), Tytan (42.6%), Lehenda (41.4%) and Kobuko (41.3%) are the leading Ukrainian varieties in terms of crude protein content (Table 4).

Analysis of the plasticity of the content of crude protein in soybean seeds showed that the regression coefficient is equal to 1.0 in almost all the studied varieties. This suggests that there is a complete correspondence between the change in crude protein content in soybean seeds and the change in growing conditions. In Tytan and Kobuko varieties, the regression coefficient is equal to 0.9. This shows that the crude protein content of these varieties is within the average group values.

It was found that the content of amino acids in soybean seeds also varied depending on the variety. The obtained results prove (Table 5) that higher amino acid values were observed in Diadema Podillia and Tytan soybean varieties of domestic selection compared to the Senator variety of foreign selection.

The highest rates of amino acids such as threonine (16.7 g/kg), leucine (25.2 g/kg), phenylalanine (16.7 g/kg), histidine (12.0 g/kg), serine (19.4 g/kg), glutamic acid (77.4 g/kg), proline (22.1 g/kg), glycine (14.1 g/kg), cystine (2.2 g/kg), aspartic acid (47.6 g/kg), arginine (26.6 g/kg) was noted in the seeds of the Tytan variety, while the Diadema Podillia variety had the highest values of valine (12.2 g/kg), methionine (3.5 g/ kg), isoleucine (12.2 g/kg) and lysine (24.0 g/kg). The lowest values of amino acids in soybean seeds were noted in the Senator variety.

Table 4. Characteristics of soybean varieties by the content of crude protein in seeds under the conditions of the Right Bank Forest Steppe, % (on average for 2020–2022)

No.	Varieties	Applicant country	Ripeness group	Crude protein content, %	Regression coefficient (plasticity) b_i
1	Diadema Podillia	Ukraine	0	41.7±0.5	1.0
2	Tytan	Ukraine	0	42.6±0.8	0.9
3	Merlin	Austria	0	39.0±0.2	1.0
4	Kioto	Canada	0	42.3±0.4	1.0
5	Vorskla	Ukraine	0	40.5±1.5	1.0
6	Lehenda	Ukraine	0	41.4±1.0	1.0
7	Kordoba	Canada	0	40.6±0.8	1.0
8	Briunensis	Canada	0	41.3±0.8	1.0
9	Senator	France	0	42.4±2.4	1.0
10	Alihator	France	0	39.1±0.4	1.0
11	Monada	Ukraine	I	41.0±2.9	1.0
12	Triada	Ukraine	I	38.9±0.5	1.0
13	Kobuko	Ukraine	I	41.3±1.4	0.9
14	Kardiff	Austria	I	37.1±1.2	1.0
15	Kent	Austria	I	39.3±1.4	1.0
16	Padua	Austria	I	40.7±0.9	1.0
17	Sultana	France	I	40.3±0.3	1.0

Note: LSD_{05}, % 1.939.

Table 5. Characteristics of soybean varieties according to the content of amino acids in ASR, g/kg

No. п/п	Amino acids	Varieties		
		Diadema Podillia	Tytan	Senator
1	Threonine	16.0	16.7	15.1
2	Valin	12.2	11.6	11.2
3	Methionine	3.5	2.5	3.2
4	Isoleucine	12.2	11.6	11.0
5	Leucine	25.0	25.2	22.7
6	Lysine	24.0	23.7	22.3
7	Phenylalanine	16.3	16.7	14.7
8	Tyrosine	11.3	11.3	10.4
9	Histidine	11.0	12.0	10.4
10	Serin	18.1	19.4	16.5
11	Glutamic acid	74.7	77.4	68.8
12	Proline	20.0	22.1	18.8
13	Glycine	13.9	14.1	13.2
14	Alanine	15.2	15.1	14.3
15	Cystine	2.1	2.2	2.0
16	Aspartic acid	44.8	47.6	41.3
17	Arginine	26.4	26.6	22.5

CONCLUSIONS

On the basis of the conducted agroecological assessment of soybean varieties of both Ukrainian and foreign selection under the conditions of the right-bank forest-steppe of Ukraine, it was noted that the overall maximum seed yield (more than 3.0 t/ha) with a weight of 1000 seeds (more than 180 g) and crude protein content (more than 40%) was provided by Tytan (3.05 t/ha, 194 g, 42.6%), Kioto (3.29 t/ha, 183 g, 42.3%) and Kobuko (3.19 t/ha, 187 g, 41.3%). Also, these varieties provided plasticity according to the above-mentioned performance indicators. In addition, the Tytan variety has higher amino acid content in the seeds. Therefore, these varieties are recommended for agricultural production for growing in seed and commercial crops, for feeding farm animals and poultry, as well as as raw material for use in the selection process.

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