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Agrobiological evaluation of collection of vegetable soybean varieties in the Forest-Steppe of Ukraine

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Purpose. Agrobiological assessment of soybean varieties *Glycine max* var. *Shirofumi* on a complex of economically valuable traits for introduction in the conditions of the Forest-Steppe of Ukraine. Selection of promising breeding forms based on morpho-biological and physiological-biochemical characteristics. **Methods.** Field, laboratory, statistical, computational and analytical. The studies were carried out in the conditions of the educational and production department of Uman National University of Horticulture during 2020–2021, using collection varieties of different ecological and geographical origin (Ukraine, Belarus, Sweden, Japan and Russia). The cultivars were assessed according to the following parameters: plant height, leaf area, net productivity of photosynthesis and indices of individual productivity (weight of beans per plant, number of seeds in a bean, etc.), productivity of green beans and biologically mature seeds and, accordingly, quality indicators of production (dry matter, sugar and protein content). The counts were carried out in the phase of the technical ripeness of the beans. **Results.** The variability of the "plant height" trait of the studied varieties had an average variation – the coefficient of variation was 22%. The results showed that the standard cultivar 'Romatnyka' and the collection cultivars 'Karikachi' and 'Astra' belong to the semi-determinant type of growth (97–109 cm), cultivar 'Fiskeby V', 'L 380-2-13', 'Fiskeby V-E5', 'SibNIISOKh 6', 'Sac', 'Vesta' belong to the determinant type of growth. According to the number of seeds in the pod, the studied varieties were clearly divided into two groups: with two-seeded beans (varieties 'Karikachi', 'Astra', 'L 380-2-13') and three-seeded beans [varieties 'Romatnyka' (standard), 'Fiskeby V', 'Vesta', 'SibNIISOX 6', 'Sac', 'Fiskeby V-E5']. The maximum yield of edamame beans was produced by varieties 'L 380-2-13' (17.3 t/ha), 'Vesta' (18.8 t/ha), 'Sac' (19.6 t/ha), 'Fiskeby V' (21.4 t/ha), 'Fiskeby V-E5' (22.4 t/ha). A significant differentiation of soybean varieties in the biochemical composition of immature beans was revealed. The dry matter content was 22.70–31.70%. The share of protein in edamame green beans was 28.2–38.6%, in biologically mature seeds its share increased to 36.1–42.8%. Among soluble sugars, the highest concentration was noted for sucrose – 7.70–9.38 mg/100 g in dry seeds, what in average amounted to 81.6–86.2% of all sugars. The presented results provide a comprehensive assessment of breeding work on soybean varieties with a low content of oligosaccharides. **Conclusions.** Evaluation of collection varieties of vegetable soybeans by the variability of morphological traits and productivity made it possible to distinguish 'Sac' variety by a complex of valuable traits for creation of new varieties of vegetable soybeans adapted to the conditions of the Forest-Steppe of Ukraine.

Keywords: *edamame; yield; protein; sugar content; seeds.*

Introduction

The consumption of soybeans has increased significantly in the world in recent years. Despite growing demand, most edamame (immature soybeans) are imported from Asian countries. Therefore, commercially viable varieties adapted to the conditions of Ukraine that meet the needs of consumers become an important component for the soybean processing segment of industrial production.

Edamame vegetable soybean (*Glycine max* var. *Shirofumi*) has been widely used for centuries in East Asia and is a common food item in Europe and North America. Due to its high protein content (with isoflavones, vitamins C and E, monounsaturated fatty acids), it is very nutritious [1–4]. The unique combination of these biochemical components allows vegetable-type soybeans to be used in a variety of food products, namely: soy milk products, tofu,

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sauces, sprouts (microgreens), fresh, frozen and canned beans.

In the USA, edamame is known as «vegetable soybean», but other common names are «edible soybean», «fresh green soybean», «garden soybean», «green soybean», «green ripe soybean», «vegetable green soybean», «immature soy», «large-seed soy», «beans for beer», «vegetable-type soybean» [5]. In North America, vegetable soybeans have been researched for more than 70 years. During 1929–1931 breeders Dorsett and Morse amassed an extensive collection of germplasm, which Morse used as starting material to create 49 edamame varieties [6].

In 1930–1940, an active stage began in the study of soybeans of the «edamame» type due to a lack of protein in the population's diet [7]. The next burst of enthusiasm for soybean vegetable research began with the rise in the growth rate of organic agriculture in the 1970s. To date, the third wave of intensive distribution and popularization of vegetable soybeans is noted.

Domestic production largely lags behind consumer demand. This is due to the fact that the greatest demand falls on residents of the United States and Western Europe. Often, the domestic consumer does not even know about the existence of this product.

One of the main obstacles for the domestic production of edamame is the general lack of competitive varieties created for the natural conditions of Ukraine. Varieties of other countries are poorly adapted, which leads to their low productivity and profitability [8]. From an agronomic point of view, it is important to provide producers with varieties that are better adapted to growing conditions, more tolerant to the effects of pests and phytopathogenic organisms, and will allow getting a high, quality yield. The consumer prefers edamame varieties that are not genetically modified, produce relatively large beans with a minimum incidence of one bean per pod [9].

High-quality edamame pods are bright green with sparse hairs (from white to gray), well shaped with a flawless surface, without damage or external defects, and contain two or more beans [10]. Edamame is harvested when the beans are still immature (between the reproductive growth stages R6 and R7), when the seeds have filled 80–90% of the pod and retain about 65% moisture [11]. In the phase of technological maturity, edamame at the R6 stage has an intense green color, a low concentration of oligosaccharides and antinutrients, as well as a high content of sucrose and a large mass of immature seeds [12, 13]. Vegetable varieties of soybeans differ from oilseeds in increased content of monosaccharides (about a third higher), sucrose (1.5 times more), and a reduced content of trisaccharides (almost 2 times). In the dry matter of vegetable soybean seeds, the proportion of mono- and oligosaccharides ranges from 14–24%, sometimes reaching 35%, but in world collections there are vegetable-type soybean samples in which the proportion of $C_{12}H_{22}O_{11}$ is higher. Such beans are more palatable and do not cause digestive problems when consumed, which is why they are also called «sweet soybeans» [14]. An important element in the introduction of vegetable soybeans with a high content of biologically active substances is the study of the productivity of the starting material *Glycine max* var. *Shirofumi* L.

Materials and research methods

Research on the technology of growing vegetable soybean varieties in the conditions of the Forest-Steppe of Ukraine was carried out in 2020–2021 on the experimental field of the Department of Vegetable Growing at the Educational and Scientific Department of Uman National University of Horticulture with coordinates 48°46' North latitude 30°14' East longitude of Greenwich of altitude 245 m above sea level. The scheme of the experiment included seven collection varieties of vegetable soybeans (Table 1).

Table 1

The origin of the collection varieties of vegetable soybeans

Number according to State Catalog of Samples of Legume cultures of the National Center for Plant Genetic Resources of Ukraine	Variety name	Country of origin
'Romatnyka' St		Ukraine
UD0200177	'Fiskeby V'	Sweden
UD02200640	'Karikachi'	Japan
UD0201068	'Astra'	Russia
UD0201080	'Vesta'	Russia
UD0201152	'SibNIISOKh 6'	Russia
UD0202500	'Sac'	Japan
UD0202625	'Fiskeby V-E5'	Belarus
UKR001:02894	'L 380-2-13'	Ukraine

A randomized field experiment was conducted. The experiment was performed in four repetitions. The area of the experimental plot was 10 m^2. Sowing of vegetable soybeans was carried out according to the scheme 45 × 5 cm (444 000 pcs./ha) on May 5–10.

Collection samples of vegetable soybeans were provided by the National Center for Ge-

netic Resources of the Plant Production Institute named after. V. Ya. Yuriev to study the suitability of cultivation for vegetable purposes and determine the technological properties of products. The presented collection samples originate from different regions; therefore they are characterized by significant differences among themselves. According to the recommendations of the Institute of Vegetable and Melon Growing of the NAAN of Ukraine, the variety 'Romantyka' was taken as the standard, since it is being studied at the Institute as a soybean variety for vegetable use.

The soil of the experimental plot is podzolized hard loamy chernozem [15]. During the study period, the weather conditions were favorable for the cultivation of vegetable soybeans. Weather conditions throughout 2020–2021 differed in the main indicators; therefore, the variability of morphological characteristics and the productivity of vegetable soybean varieties were assessed objectively.

The technology for growing collection varieties of vegetable soybeans was generally accepted for the Forest-Steppe.

During 2020–2021 the productivity and biochemical composition of vegetable soybean, depending on the variety, were studied in field and laboratory experiments in the conditions of the Right-Bank Forest-Steppe of Ukraine.

Biometric measurements (plant height, cm; leaf area, thousand m^2; number of shoots, pcs/plant; number of seeds, pcs/bean; net primary productivity of photosynthesis in the period between phases of full pod – technical maturity, g/day/m^2) and indicators of individual productivity (mass of beans, g/plant) were carried out in four repetitions on 100 typical plants in each.

The net primary productivity of photosynthesis (NPPF) was determined by the phases of plant development (full pod – technical ripeness) by dividing the growth of phytomass for a certain period of time by the average leaf area according to the formula:

$$\Phi_{ч} = \frac{2 \cdot (B_2 - B_1)}{(L_1 + L_2) \cdot T} \quad (1)$$

The dry matter was determined by the drying method according to the State Standard 7804:2015 [16]. Sugars were extracted from crushed (1 g) unripe beans with water and analyzed by high-performance liquid chromatography (HPLC) using a Waters-2695 HPLC chromatograph. Measurement of sugar content was determined using a Waters 410 differential refractometer according to the Johansen and others method. [17]. Protein content – by the Kjeldahl method, according to the State Standard ISO 5983-2003 [18].

To analyze the variability of traits, we used the index of the coefficient of variation, a relative value characterizing the dispersion (variability) of a trait. This indicator is the ratio of the SD standard deviation to the arithmetic mean, and is expressed as a percentage:

$$CV = \frac{SD}{X} \quad (2)$$

The coefficient of variation was used to compare the variability of traits expressed in different units of measurement. The degree of variation was measured on a ratio scale:

CV < 10% – weak variation;

CV 11–25% – average;

CV > 25% – significant [19] using computer programs Excel and Statistica 10.

Statistical processing of the obtained results was carried out with the calculation of the arithmetic mean (x) of the standard deviation (SD), calculated using Microsoft Excel 2016. The obtained data were compared using analysis of variance.

Research results

When evaluating the collection material, breeders analyze, in addition to the general vegetation period, the interphase period «germination-flowering», showing the rate of formation of soybean vegetative organs. This indicator mainly depends on genetic factors, to a lesser extent – on agro-climatic conditions. The duration of the growing season of soybeans is controlled by the dominant allele of the E1 gene [20]. For the Forest-Steppe zone of Ukraine, the duration of the growing season should be about 55–65 days; with a longer period, there is a possibility that the variety will not have time to produce a seed crop. When creating early ripening vegetable varieties, it is important to take into account that some varieties in the process of ontogenesis have a longer period of vegetative development, but in general, their ripening time does not increase [21].

Studies revealed that the processes of growth and development of vegetable soybeans during the growing season differed significantly depending on the plant variety. Seedlings of all studied varieties appeared 9–11 days after sowing, while the onset of the budding phase in the samples of 'Astra', 'Vesta' and 'SibNIISOKh 6' varieties occurred 24–30 days later than others.

On the basis of the «vegetation period» plants differed significantly. The technological

maturity of beans came on 61–100 days from seedlings emergence. This makes it possible to create a conveyor scheme for the consumption of green edamame beans by using varieties of different ripeness groups.

According to the results of research, it was established that 'Romatnyka' standard variety and the 'Karikachi' and 'Astra' collection specimens belong to the semi-determinant type of growth. Plants of 'Karikachi' and 'Astra' varieties in the phase of technological maturity were larger. Compared to the standard, their height differed by 11.3 and 12.4%. Collection varieties 'Fiskeby V', 'L 380-2-13', 'Fiskeby V-E5', 'SibNIISOKh 6', 'Sac', 'Vesta' belong to the determinant type of growth, the height of which was in the range of 62.0–78.0 cm, which is 19.6–36.1% less than the standard.

It is known that 90–95% of the dry matter of crop yields is created by photosynthesis in leaves. Taking this into account, the yield of agricultural crops largely depends on the dynamics of the increase in the area of plant leaves and the intensity of their work during the growing season. The leaf surface area is a rather variable value, which formation is significantly influenced by varietal characteristics, conditions of moisture supply, nutrition and other technological methods of cultivation. According to this indicator, samples of vegetable soybeans were of medium variant – CV = 11%. The largest area of the assimilation surface was produced by plants of the varieties 'Astra', 'Karikachi', 'Fiskeby V', 'Sac', 'Fiskeby V-E5', 'Vesta' – 30.6–39.0 thousand m^2/ha, which is more than the standard by 1.3–29.1% (Table 2).

Table 2

Productivity parameters of different varieties of vegetable soybeans (2020–2021)

Sample	Productivity parameters of vegetable soybeans in the phase of technological maturity of beans					
	Plant height, cm	Leaf area of crops, thousand m^2	Number of shoots, pcs./plant	Number of beans, pcs./plant	Number of seeds, pcs./bean	NPPF full pod - technological maturity, g/m^2/day
'Romatnyka St	97±5.2	30.2±0.64	2.0±0.11	31.0±1.9	2±0.10	2.52±0.07
'Fiskeby V'	62±1.7	34.6±0.98	2.0±0.08	31.8±0.7	2±0.07	2.65±0.14
'Karikachi'	108±3.3	33.0±1.13	2.0±0.06	34.0±0.5	2±0.07	2.41±0.04
'Astra'	109±2.9	30.6±1.60	2.5±0.07	38.0±2.1	3±0.07	2.43±0.07
'Vesta'	78±3.1	39.0±0.99	2.5±0.09	48.5±1.2	3±0.07	2.95±0.09
'SibNIISOKh 6'	70±2.5	30.0±0.83	3.0±0.11	49.0±1.3	3±0.21	2.55±0.08
'Sac'	72±0.6	35.0±1.12	3.0±0.08	58.0±1.3	3±0.04	2.74±0.07
'Fiskeby V-E5'	67±3.6	37.5±1.32	3.5±0.17	71.0±5.1	3±0.13	2.83±0.10
'L 380-2-13'	64±2.9	28.1±0.89	4.0±0.08	76.0±1.7	3±0.06	2.62±0.05
Xmed.	80.8	33.1	2.7	48.6	2.7	2.6
SD	17.7	3.5	0.7	15.8	0.5	0.2
CV, %	22	11	25	33	18	6

A smaller leaf area compared to the standard was produced by plants of 'L 380-2-13', 'SibNIISOKh 6' varieties – 28.1 and 30.0 thousand m^2/ha, which is less than the standard by 0.7 and 7.0%.

In terms of the number of shoots, the plants of most samples varied significantly (CV = 25%). The maximum number of shoots was formed by plants of the 'Fiskeby V-E5' variety – 4 pcs./plant, which is 60% more than the standard, or 1.5 pcs./plant. Varieties 'Karikachi', 'Astra', 'Vesta' were characterized by slightly higher rates relative to the standard for this trait – 3.0–3.5 pcs./plant, which is 0.5–1.0 pcs/plant, more than the standard or 20–40%. Plant varieties 'Fiskeby V', 'SibNIISOKh 6', 'L 380-2-13' formed two shoots, which is less than the standard by 0.5 pcs., that is, 50% of the plants formed 2 and 3 shoots per plant.

The net primary productivity of photosynthesis varied little in all variants of the experiment (CV = 6%). The maximum net primary productivity of photosynthesis was observed in samples 'Vesta' – 2.95 g/m^2/day and 'Fiskeby V-E5' – 2.83 g/m^2/day, which is 17.1 and 12.3% more than the standard. The net primary productivity of photosynthesis in 'Fiskeby V', 'Sac' samples was significantly higher than 'Romantyka' variety – 2.65 and 2.74 g/m^2/day, which is more by 5.2 and 8.7%.

In terms of the number of beans per plant, samples 'Sac', 'Fiskeby V-E5', 'Astra' significantly prevailed over 'Romantyka' variety – 58–76 pcs./plant, which is more by 19.6–56.7%. A smaller number of beans in comparison with the standard was formed by samples 'Fiskeby V', 'SibNIISOKh 6', 'Karikachi', 'L 380-2-13' – 31–38 pcs./growth, which is 21.6–36.1 less %. The variation of this feature was strong – CV = 33%.

In terms of the number of seeds in one bean, the varieties were medium variable, the coeffi-

cient of variation was 18%, and they were clearly divided into two groups: with two-seeded beans (Karikachi', 'Astra', 'L 380-2-13') and three-seeded beans ('Romantyka' St, 'Fiskeby V', 'Vesta', 'SibNIISOKh 6', 'Sac', 'Fiskeby V-E5').

The marketable yield for vegetable purposes and the efficiency of cultivation in general depend on the mass of beans. The variation of this feature was significant, the coefficient of variation was 29%. Varieties 'L 380-2-13', 'Sac', 'Vesta', 'Fiskeby V', 'Fiskeby V-E5' were characterized by a significantly greater mass of beans. Thus, samples 'Vesta', 'Fiskeby V', 'Fiskeby V-E5' had beans weighing 163–176 g/plant, which is 81.1–95.6% more than the standard; samples 'L 380-2-13', 'Sac' – 138.6 and 156.6 g/plant (+54.0 and 74.0%). Only one variety 'Karikachi' was characterized by a lower mass of beans – 81 g/plant, which is 10% less than the standard.

The formation of a crop is a complex set of numerous physiological and biochemical processes of the vital activity of a plant organism, the intensity of which is influenced by a large number of factors. The yield value of agricultural crops depends on soil and climatic conditions, characteristics of the biology of a culture, technological methods and other factors.

Crop yield is an indicator on which the expediency and efficiency of cultivation technology depends. Most of the collection samples significantly exceeded the standard variety 'Romatnyka', their yield fluctuated within 11.3–22.4 t/ha. Varieties 'L 380-2-13' (17.3 t/ha), 'Vesta' (18.8 t/ha), 'Sac' (19.6 t/ha), 'Fiskeby V' (21.4 t/ha), 'Fiskeby V-E5' (22.4 t/ha), were characterized by maximum yield, which was 6.2–98.2% more than the standard. Edamame yield variation was also strong with CV = 27%.

Consequently, the yield of vegetable soybeans largely depends on varietal characteristics, which differ significantly from each other for all indicators.

It is advisable to evaluate the productivity of varieties not only by the yield of marketable products, but also by the possibility of obtaining high-quality seed. High seed yield above the standard was obtained in samples 'L 380-2-13' (2.88 t/ha), 'Sac' (3.10 t/ha), 'Vesta' (3.10 t/ha), 'Fiskeby V' (3.63 t/ha), 'Fiskeby V-E5' (4.00 t/ha), which exceeded the standard by 8.0–64.8% (Table 3).

Table 3

Yield and quality parameters of vegetable soybean samples

Sample	Weight of beans, g/plant	Bean yield, t/ha	Seed yield, t/ha	Dry matter, %
'Romatnyka' St	90.0±2.4	11.3±0.40	2.00±0.06	31.70±0.62
'Fiskeby V'	171.0±6.2	21.4±0.41	2.11±0.18	23.00±1.58
'Karikachi'	81.0±1.5	10.5±0.36	2.20±0.06	32.00±1.92
'Astra'	90.0±2.8	12.7±0.55	2.38±0.11	30.70±1.62
'Vesta'	163.0±12.0	18.8±0.45	2.88±0.08	28.00±1.09
'SibNIISOKh 6'	95.4±2.4	12.0±0.24	3.08±0.16	31.10±0.79
'Sac'	156.6±9.0	19.6±0.62	3.08±0.09	26.00±1.26
'Fiskeby V-E5'	176.0±5.6	22.4±0.35	3.63±0.21	22.70±1.29
'L 380-2-13'	138.6±4.4	17.3±0.82	4.00±0.04	28.60±1.26
Xmed.	129.1	16.2	2.80	28.20
SD	37.2	4.4	0.7	3.4
CV, %	29	27	23	12

Dry matter is the main indicator on which the energy and bioenergy efficiency of the production of any product depends, so the analysis of this indicator was carried out in sufficient detail. 'Karikachi' sample dominated the standard in terms of solids content, although not significantly – 32.0%. The dry matter of varieties 'Vesta', 'L 380-2-13', 'Astra', 'SibNIISOKh 6' was insignificantly less than the standard – 28.0–31.1%, which is less than the variety 'Romatnyka' by 1.9–11.7%. Samples 'Fiskeby V-E5', 'Fiskeby V', 'Sac' had a dry matter of 22.7–26.0%, which is 18.0–28.4% less than the standard.

The study of crude protein content in the immature grain of vegetable soybean indicated a significantly lower content of it relative to biologically mature grain. The protein concentration of edamame beans was in the range of 28.2–38.6%, which is less than the same indicator in biologically mature grain – 36.1–42.8% (Fig. 1).

A slightly higher protein content relative to the standard was noted in one sample – 'Karikachi' – 38.6% in the phase of technological maturity and 42.8% in the phase of biological maturity. Collection samples 'Fiskeby V-E5', 'Fiskeby V', 'Vesta', 'Sac', 'SibNIISOKh 6', 'L 380-2-13', 'Astra' accumulated less protein in the grain relative to the standard by 5.5–25.8% in the phase of technological maturity and 1.2–15.1% in the phase of biological maturity.

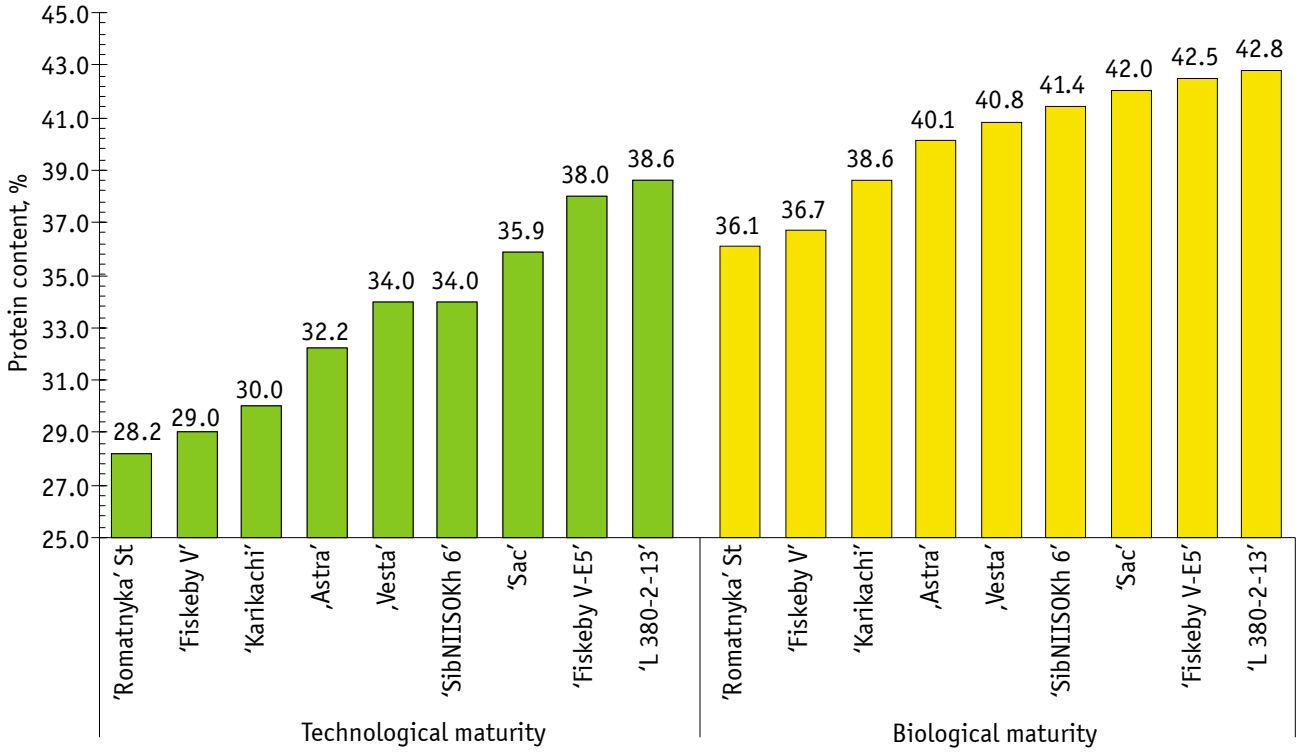

Fig. The content of crude protein at different stages of bean ripeness in edamame, depending on their variety (2020–2021), % ($LCD_{0.05\ t.m.}$ = 2.14; $LCD_{0.05\ b.m.}$ = 2,92)

The content of soluble sugars, including monosaccharides (fructose, glucose), disaccharides (sucrose), and oligosaccharides (raffinose and stachyose) in edamame seeds are shown in Table 4. In plant samples of 'Sac' and 'Arikachi' varieties fructose concentration was the highest – 0.96–1.12 mg/100 g, this is 26.3–47.4% more relative to the standard. Samples 'SibNIISOKh 6', 'Fiskeby V-E5' had somewhat lower fructose content, but exceeded the standard sample by 15.8–17.1%.

Table 4

Soluble sugar content in vegetable soybeans

Variety	Sugar content, g/100 g dry matter (X ± SD)				
	fructose	glucose	sucrose	raffinose	stachyose
'Romatnyka' St	0.76±0.012	0.24±0.005	9.26±0.15	0.45±0.013	0.06±0.001
'Fiskeby V'	0.82±0.019	0.21±0.006	9.14±0.35	0.39±0.010	0.08±0.003
'Karikachi'	0.96±0.007	0.15±0.005	8.24±0.22	0.27±0.008	0.11±0.005
'Astra'	0.98±0.026	0.15±0.007	7.70±0.04	0.21±0.012	0.11±0.003
'Vesta'	0.75±0.020	0.21±0.009	9.31±0.31	0.47±0.019	0.06±0.003
'SibNIISOKh 6'	0.88±0.022	0.18±0.009	8.64±0.18	0.36±0.012	0.09±0.004
'Sac'	1.12±0.046	0.13±0.004	6.82±0.22	0.16±0.004	0.13±0.003
'Fiskeby V-E5'	0.89±0.025	0.17±0.005	8.41±0.17	0.31±0.014	0.10±0.002
'L 380-2-13'	0.74±0.016	0.22±0.005	9.38±0.27	0.52±0.031	0.06±0.002
Xmed.	0.88	0.18	8.54	0.35	0.09
SD	0.12	0.04	0.81	0.11	0.02
CV, %	14	19	10	33	27

The concentration of glucose in all studied samples of vegetable soybeans varied markedly within the range of 0.13–0.24 mg/100 g (CV = 19%) and was below the standard by 8.3–45.8%. In terms of the concentration of sucrose and raffinose, the same tendency was observed – the studied samples were characterized by the lowest concentration, with the exception of individual samples ('Vsesta' and 'L 380-2-13'). However, the sucrose content varied little – CV = 10%, and the raffinose content very strongly (CV = 33%).

The samples significantly varied in the content of stachyose (CV = 27%); most of the studied samples significantly exceeded the standard, with the exception of samples of 'Vesta' and 'L 380-2-13' varieties, where its content was equal to the standard.

The results of the study indicate a very strong differentiation of varieties according to all economic characteristics.

Conclusions

The results show that even with minor variations in genotype, vegetable soybean varieties/samples are reasonably similar to grain-type soybeans. Our results also support the benefits of edamame as a low oligosaccharide dietary product. A promising variety is UD0202500 'Sac' originating from Japan. It is characterized by large seeds of bright green color at the stage of technological and biological maturity, increased yield of green beans – 19.6 t/ha, seeds – 3.08 t/ha; has fairly high protein content – up to 35.9% in green beans and up to 42.0% in mature seeds. The obtained results provide useful information about seed and nutritional quality of edamame for further breeding practice and prove that the introduced vegetable soybean varieties are suitable for both vegetable production and high-quality seeds.

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Мета. Агробіологічне оцінювання сортів сої *Glycine max* var. *Shirofumi* за комплексом господарсько-цінних ознак для інтродукції в умовах Лісостепу України. Добір перспективних селекційних форм за морфо-біологічними та фізіолого-біохімічними характеристиками. **Методи.** Польові, лабораторні, статистичні, розрахунково-аналітичні. Дослідження проводили в умовах навчально-виробничого відділу Уманського національного університету садівництва впродовж 2020–2021 рр., використовували колекційні сорти різного еколого-географічного походження (Україна, Білорусь, Швеція, Японія і Росія).

Оцінювання сортів проводили за наступними параметрами: висота рослин, листкова площа, чиста продуктивність фотосинтезу та показники індивідуальної продуктивності (маса бобів з однієї рослини, кількість насінин у бобі та ін.), врожайність зелених бобів та біологічно зрілого насіння і відповідно якісні показники продукції (суха речовина, вміст цукрів і протеїну). Обліки проводили у фазі технічної стиглості бобів. **Результати.** Мінливість ознаки «висота рослини» досліджуваних сортів мала середню варіацію – коефіцієнт варіювання складав 22%. Результати вказали, що сорт-стандарт 'Романтика' та колекційні сорти 'Karikachi' та 'Астра' відносяться до напівдетермінантного типу росту (97–109 см), сорти 'Fiskeby V', 'Л 380-2-13', 'Fiskeby V-E5', 'СибНИИСОХ 6', 'Sac', 'Веста' належать до детермінантного типу росту. За кількістю насінин у стручку досліджувані сорти чітко розділилися на дві групи: з двонасінними бобами (сорти 'Karikachi', 'Астра', 'Л 380-2-13') та тринасінними бобами (сорти 'Романтика' (St), 'Fiskeby V', 'Веста', 'СибНИИСОХ 6', 'Sac', 'Fiskeby V-E5'). Максимальну врожайність бобів едамаме формували рослини сорту 'Л 380-2-13' (17,3 т/га), 'Веста' (18,8 т/га), 'Sac' (19,6 т/га), 'Fiskeby V' (21,4 т/га), 'Fiskeby V-E5' (22,4 т/га). Виявлено істотну диференціацію сортів сої овочевої за показниками біохімічного складу недозрілих бобів. Сухий залишок становив 22,70–31,70%. Частка протеїну у зелених бобах едамаме становила 28,2–38,6%, у біологічно зрілому насінні його частка зростала до 36,1–42,8%. Серед розчинних цукрів найбільшу концентрацію відзначено для сахарози – 7,70–9,38 мг/100 г сухого насіння, що в середньому складало 81,6–86,2% усіх цукрів. Наведені результати забезпечують комплексну оцінку для селекційної роботи над сортами сої овочевої з низьким вмістом олігосахаридів. **Висновки.** Оцінювання колекційних сортів сої овочевого напряму використання за варіабельністю морфологічних ознак та продуктивністю дозволило виділити серед інтродукованих колекційних сортів за комплексом цінних ознак для використання у селекційному процесі сорт 'Sac' для створення нових сортів сої овочевого напряму, адаптованих до умов Лісостепу України.

Ключові слова: *едамаме; урожайність; протеїн; вміст цукрів; насіння.*

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