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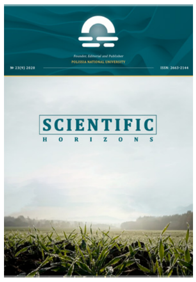

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Selection of highly adaptive source material of watermelon for selection for early ripening

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Abstract. In terms of watermelon selection, the issue of stability of obtaining high yields in the conditions of manifestation of abiotic stressors of the external environment is relevant. The purpose of this study was to select a highly adaptive source material of watermelon according to the duration of the growing season and its components for use in breeding for early ripening. 101 collection samples of watermelon from 9 countries of the world were analysed. The study was based on the following methods: general scientific, measurement and weight, calculation, statistical. The watermelon collection was divided into ripeness groups and the sample was ranked according to the "duration of the seedling-ripening period". The study established the amplitude

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(A_m) and range of variation (*Lim*) of the signs of the duration of the components of the growing season. Samples with the smallest individual interphase periods were selected for use in selection for early ripening. The study found V_i – general adaptive capacity (GAC), $\sigma^2 SAC_i$ – specific adaptive capacity (SAC), Sg_i – genotype stability, b_i – regression coefficient of genotype response to changing conditions (plasticity), SVG_i – selection value of the watermelon collection genotype based on the "duration of the growing season period". According to the general adaptive capacity, the samples with the shortest duration of the "seedling – ripening" period were selected – 19 samples (V_i=-11.72...-6.05). As the most stable genotypes according to the "duration of the growing season" characteristic, 32 collection samples with a low value of the specific adaptive capacity indicator were selected, 23 of which are early ripening. The high stability of the genotype (*Sgi*) according to the characteristic "duration of the seedling-ripening period" was determined in 31 collection samples, of which 24 were early ripening. Based on the results of determining the regression coefficient (ecological plasticity coefficient), according to the characteristic "duration of the growing season", the collection samples of watermelon were divided into three groups – with low (b_i=0.01-2.20), medium (b_i=2.21-4.22), and high (b_i=4.23-6.24) ecological plasticity. According to the selection value of the genotype according to the trait "duration of the seedling-ripening period", 18 collection samples had high indicators (SVG_i=110.22-119.92), which are valuable for use in selection work with watermelon as sources of the characteristic "early ripeness"

Keywords: watermelon; selection; early ripening; adaptive capacity; stability; plasticity; selection value

INTRODUCTION

It is important to have a year-round pipeline supply of products for adequate nutrition of the population. For vegetable and melon products, it is important to receive products in an earlier period, which will provide the population with wholesome vitamin products and contribute to strengthening food security. A biological feature of melon crops, including watermelon, is that they change their growing season depending on the weather conditions of the year: in hot, dry years, the number of days from germination to the beginning of ripening is sharply reduced, and therefore some genotypes can shift from later-ripening to early-ripening groups and middle-early and vice versa. The greater the sum of active temperatures, the earlier the appearance of female flowers and early ripening, and vice versa, which changes the duration of the growing season. For agricultural production, the stability of receiving high-quality products in the planned terms is important, which can be ensured to a greater extent only by a highly adaptive genotype. The ability of ecological adaptation of newly created genotypes to changes in environmental factors is a separate problem in modern agricultural production, and therefore the creation of highly adaptive heterosis hybrids is still relevant.

According to O. Sergienko & Z. Linnik (2022), it is precisely the lack of high-yielding varieties in the production that are adapted to soil and climatic conditions, namely extreme ones, that is the main limiting factor without which a significant increase in the productivity of melon crops, including watermelon, is impossible. Therefore, at the current stage of the development of agricultural science, researchers (Vozhehova, 2018; Naumov & Lymar, 2019) pay attention to the urgent issue of creating and introducing environmentally sustainable genotypes into production, which allow for stable high yields. The theoretical basis of adaptive crop production is ecological plant genetics. The ecological-genetic approach to breeding allows developing ways and methods of rational use of genotypes and obtaining new varieties and hybrids that are resistant to adverse environmental factors, obtaining information about the norm of the reaction of the genotype, etc. (Vasko *et al.*, 2019). Thus, for production, genotypes with high adaptive capacity are valuable, which can provide the maximum level of manifestation of valuable economic traits, including early ripening in changing environmental conditions. Highly adapted starting material allows creating new varieties and hybrids in different areas of selection, specifically, selection for early ripening is impossible without stable sources and donors.

The highly adaptive source material is selected by breeders for most vegetable and melon crops. Thus, at the Dnipropetrovsk research station of the Institute of Vegetable and Melon of the National Academy of Agrarian Sciences, due to the results of breeding research by I. Sydorka & V. Zavertaluk with watermelon culture under artificial agro-climatic conditions (variable sowing dates and plant feeding area), the "Method of selection of plastic lines and hybrids of ordinary watermelon" was developed in 2015 and adaptive source material was selected based on valuable economic characteristics. For carrot culture (*Daucus carota* L.), the analysis of the adaptive potential of the original selection material performed by I. Pidlubenko *et al.* (2022) helped identify ecologically stable sources with high general and specific adaptive capacity for selection for the yield of root crops and β-carotene content. The analysis of correlations of quantitative traits and their interaction with biotic and abiotic factors of the environment helped S. Kondratenko & Yu. Lancaster (2022) significantly increase the efficiency of selection work on the creation of highly adaptive forms of zucchini with a stable phenotypic response of the genotype to changing growing conditions. According to N. Vorobiova (2021), it was proved that environmental factors have the greatest influence on the tomato yield, and therefore, for successful selection, it is necessary to create highly adaptive source material for each direction of selection.

In the matter of watermelon breeding, according to Z. Sych (2021), the issue of insufficient stability and the level of fulfilment of the potential of early ripening and yield to provide valuable vitamin products is still relevant, and can be solved only by creating new early-ripening genotypes with a complex of valuable economic traits and high adaptive capacity.

The world's gene pool of watermelon collections is the most valuable source of creating new competitive genotypes of the early ripeness group, which combine resistance to biotic and abiotic factors of the environment with other economically valuable traits. Ukrainian researchers V. Kirian *et al.* (2021), Z. Linnik *et al.* (2021) believe that the investigation of the global genetic potential of watermelon culture using an integrated approach in determining stable sources of selection traits, their involvement in hybridization with the subsequent use of analytical selection methods allows creating a diverse source material and fruitfully using it in varietal and heterosis selection of this culture.

That is why the purpose of this study was to determine the adaptive potential of the watermelon collection for their further use in various areas of selection, specifically for early ripening.

MATERIALS AND METHODS

Experimental studies were conducted in 2018-2020, in the northern part of the Left Bank Forest-Steppe of Ukraine, in the central moderately humid area of the Kharkiv region. The experiments were conducted on soils inherent in the Forest-Steppe zone – typical low-humus medium loamy chernozem on loess rocks (pH of salt extract – 5.7; sum of absorbed bases – 26.0 mg-eq per 100 g of soil; hydrolytic acidity – 2.8 mg-eq per 100 g of soil; humus content – 4.3%; hydrolyzable nitrogen – 139.0 mg/kg; mobile phosphorus – 106-119 mg/kg and exchangeable potassium – 93 mg/kg of soil). The climate of the experimental area is temperate-continental. Experiments were located on a natural infectious background.

The object of the study was collection samples of watermelon – 101 variety samples from 9 countries of the world (from Ukraine, China, the USA, Moldova, Kazakhstan, Thailand, the Czech Republic, Italy). The Max Plus variety (Ukraine) served as the standard. A study of the adaptive potential of the watermelon collection by the length of the growing season was conducted. Phenological observations were made noting the beginning and end of each of the phases: emergence, formation of the third true leaf, flowering, fruiting, biological maturity. The beginning of the phase was considered when 10%, and the end – 75% of the total number of plants on the plot entered the corresponding phase. According to the results of the phenological study, the samples were divided into four groups of ripeness according to the length of the "seedlings – ripening" period: early ripening (65-80 days), medium-early (81-85 days), medium-ripening (86-95 days) and medium-late (96-105 days). Biometric measurements of plants and fruits (stem length, fruit diameter, ovary diameter, 10 internode length, leaf length, leaf base width) were performed on 10 plants of each genotype. Harvesting and accounting of the harvest in nurseries was performed manually, using the weighing method with the division of fruits into fractions: large, medium, small, non-marketable.

The following indicators were determined: V_i – general adaptive capacity (GAC), $\sigma^2 SAC_i$ – specific adaptive capacity (SAC), Sg_i – genotype stability, b_i – regression coefficient of the genotype's response to changing conditions (plasticity), SVG_i – selection value of the genotype. Plant growing technology is generally accepted for the Forest-Steppe zone of Ukraine (DSTU 3805-98, 1998; DSTU 5045:2008, 2008). Seeds were sown in the first or second decade of May, depending on weather conditions. The sowing scheme in the experiments was 1.4×0.7 m. The registered area of the plot was 19.6 m^2. Sowing was performed manually as needed, with water added to the hole. During the vegetation period, two manual weedings and three inter-row soil treatments were performed to care for the plants.

The system of nutrition and protection of watermelon plants was performed according to scientific and practical recommendations (Kuts *et al.*, 2021). The study was conducted pursuant to the generally accepted methods of selection work (Horova & Yakovenko, 2001; Lymar *et al.*, 2001; Korniienko *et al.*, 2016). The collection samples were chosen and evaluated according to different selection areas per the recommendations (Serhiienko *et al.*, 2020; Ivchenko *et al.*, 2022; Vitanov *et al.*, 2022). The methodology (Kilchevskiy & Khotyleva, 1997) was used to estimate the parameters of adaptive capacity and stability of genotypes. The coefficient of ecological plasticity (b_i) was calculated according to the method described in (Eberhart & Russel, 1966). Statistical and mathematical processing of the obtained research results was performed using the Statistica program.

RESULTS AND DISCUSSION

According to the results of phenological observations, it was established (Table 1) that the group of early ripening samples was the most numerous both in average data and in individual years – 57% in 2018, 76% in 2019, and 68% in 2020. According to average data (X_{med}), 73 samples of the collection are classified as early-ripening. The middle-early group – 33% of samples (2018), 4% (2019), and 25% (2020), and 12 samples of the collection on average in 3 years. 7% of samples (2018), 9% (2019), and 7% (2020) were classified as medium-ripening. During 3 years of research, 15 collection samples were assigned to the medium-ripening group. The group of middle-late samples was the least numerous – according to three years of data, only 1 sample of the collection is attributed to it, but the study observed the following manifestation of the characteristic over the years – 4% of samples in 2018, 12% in 2019, and 1% in 2020.

***Table 1.** Distribution of collection samples of watermelon according to the duration of the period "seedlings-ripening" (2018-2020)*

Ripening group		Accession percentage and number			
		%			N
		2018	2019	2020	$\bar{X}$
1	Early-ripening (65-80 days)	57	76	68	73
2	Middle-early (81-85 days)	33	4	25	12
3	Medium-ripening (86-95 days)	7	9	6	15
4	Middle-late (96-105 days)	3	11	1	1
Total (101 accessions)					
"seedling-ripening" period length, days					
$\bar{X}$		80.05	77.32	76.79	78.05
Ij		2.00	-0.74	-1.26	-
X_{min}		63	66	62	64
X_{max}		103	103	97	101
A_m - X_{max} - X_{min}		40	37	35	37

***Source:** compiled by the authors*

The limit and amplitude of variation of signs of the duration of the growing season in collection samples were established. 44 samples were picked for selection for early ripening, which during the three-year study consistently had a period "seedlings–ripening" of less than 80 days.

To confirm the statistical dependence of the characteristic "duration of the growing season" on external environmental factors, the sample was ranked according to the characteristic "duration of the seedling-ripening period". The calculated Spearman rank correlation coefficient was ρ=0.69, which, according to the Chaddock scale, indicates a significant correlation dependence. According to the entire sample, 50% of the samples of each year were consistently in a certain ripening group, these are 44 early-ripening samples, 3 – middle-early, 2 – medium-ripening, and 1 middle-late sample. It was found that 24% of the variety samples of the collection slightly changed the length of the growing season in certain years, and therefore 17 early-ripening samples increased the growing season and were classified as middle-early, 3 middle-early samples were classified as early-ripening, and 4 medium-ripening samples in certain years were classified as middle-late. On 26% of the samples of the collection, the conditions of the year had a considerable influence.

The limit and amplitude of variation of the signs of the components of the growing season in the collection samples of watermelon were established (Table 2).

***Table 2.** Variability of the characteristics of the components of the growing season in collection samples of watermelon, 2018-2020*

Limits and amplitude of variation		Interphase length, days				
		Emergence–stem formation	Emergence – anthesis of female flowers	Emergence – fruit setting	Anthesis of female flowers – fruit setting	Emergence – ripening
2018	*Lim*	22-34	32-49	40-58	3-18	63-103
	Am	12	17	18	15	40

Table 2, Continued

Limits and amplitude of variation		Interphase length, days				
		Emergence – stem formation	Emergence – anthesis of female flowers	Emergence – fruit setting	Anthesis of female flowers – fruit setting	Emergence – ripening
2019	*Lim*	19-31	28-49	35-51	1-10	66-103
	Am	12	21	16	9	37
2020	*Lim*	13-26	28-43	32-52	1-10	62-97
	Am	13	15	20	9	35
$\bar{X}$	*Lim*	18-30	28-42	36-54	2-12	64-101
	Am	12	18	18	10	37

Source: *compiled by the authors*

The analysis of the duration of the growing season and its components showed that the limit of variation (*Lim*) of the duration of the "seedling–ripening" period of samples in 2018 was 63...103 days, in 2019 – 66....103 days, in 2020 – 62...97 days. The amplitude of variation (A_m) of the duration of the "seedling–ripening" period in 2018 was equal to 40 days, in 2019 – 37 days, in 2020 – 35 days, which indicates that the weather conditions of the growing season in 2020 were more favourable for most watermelon samples and they show characteristics of early ripeness. That is why the early-ripening forms were selected based on the results of provocative research under the conditions of 2018 and 2019, which will further increase the efficiency of the selection process.

On average, over the years of study, the limit of character variation was equal to the duration of the periods: "seedling-stem formation" *Lim*=18...30 days; "seedling-anthesis of female flowers" *Lim*=28...42 days; "seedlings-fruit setting" *Lim*=36...54 days; "anthesis of female flowers-fruit setting" *Lim* = 2...12 days; "seedling-ripening" *Lim*=64...101 days. The amplitude of variation (A_m) of the duration of the components of the growing season ranged from 10 to 37 days.

For use in selection for early ripening, samples with the smallest individual interphase periods are valuable. According to the study results, groups of the following samples were identified, namely: "seedling–stem formation" – 10 samples: Yanusyk, Skarb, Snezhok, Alyy Sladkiy, Medovyk, Sakharnyy Malysh, Kytay No. 3, Wm 19, Ganosik, and Minimeloni – "seedling-anthesis of female flowers" – 3 samples: Zhyoltyy Ranniy, Monomakh, Yanusyk;

– "seedlings-fruit setting" – 8 samples: Shapka Imperatora, Yanusyk, Medovyk, Syurpryz, Pivnichne Siaivo, Borysfen, Karapuz, Zhyoltyy Ranniy;

– "anthesis of female flowers-fruit setting" – 3 samples: Snezhok, Medovyk, Lyshchyna Kust;

– "seedling-ripening" - Syurpryz, Tailand 1, Karapuz, Lezheboka Medovyi, Podarok Solntsa, Zhyoltyy Ranniy ($\bar{X}$<70 days).

Parameters of ecological variability of collection samples of watermelon based on the characteristic "duration of the growing season" were established for three years of the study. Collection samples that were highlighted in terms of adaptability for selection for early ripening are presented in Table 3 ($\bar{X}$<70 days).

Table 3. *Parameters of environmental variability of watermelon collection samples, highlighted in terms of adaptability according to the characteristic "duration of the seedling-ripening period" (average for 2018-2020)*

seq. no.	Collection sample	The duration of the "seedling-ripening" period, days					
		X_{med}	V_i	σ^2SAC_i	Sg_i	b_i	SVG_i
1	Maks Plius	81.00	2.95	7.00	3.27	-1.15	97.44
2	Bolshaya Pekinskaya Radost	78.67	0.61	4.33	2.65	-0.50	104.37
3	Syurpyz	67.00	-11.05	3.00	2.59	0.98	118.88
4	Sladkiy Briliant	70.00	-8.05	28.00	7.56	2.85	86.88
5	Atamanskyi	79.00	0.95	4.00	2.53	0.89	104.70
6	Tailand No. 1	69.00	-9.05	13.00	5.23	1.87	101.62
7	Yarylo (Fliura Market)	78.00	-0.05	1.00	1.28	0.45	113.85
8	Pivnichne Siaivo	70.33	-7.72	2.33	2.17	0.86	117.22
9	Borysfen	77.00	-1.05	1.00	1.30	0.53	114.85

Table 3, Continued

seq. no.	Collection sample	The duration of the "seedling-ripening" period, days					
		X_{med}	V_i	$\sigma^2 SAC_i$	Sg_i	b_i	SVG_i
10	Foton 1	77.33	-0.72	2.33	1.98	0.86	110.22
11	Foton 2	72.33	-5.72	2.33	2.11	0.86	115.22
12	Favoryt	71.33	-6.72	2.33	2.14	0.86	116.22
13	Karapuz	67.33	-10.72	5.33	3.43	1.31	113.85
14	Lezheboka Medovyi	69.00	-9.05	13.00	5.23	1.87	101.62
15	Costa Rica	71.33	-6.72	6.33	3.53	1.39	108.16
16	Lyshchyna Kust	75.67	-2.39	0.33	0.76	-0.33	119.63
17	Arb. Kust Lyshchyna	76.67	-1.39	1.33	1.51	0.65	113.92
18	Wm 16	75.67	-2.39	1.33	1.53	0.65	114.92
19	Wm 18	75.67	-2.39	1.33	1.53	0.65	114.92
20	Wm 19	70.67	-7.39	1.33	1.63	0.65	119.92
21	Wm 20	75.67	-2.39	1.33	1.53	0.65	114.92
22	Wm 23	71.33	-6.72	1.33	1.62	0.41	119.26
23	Sladkiy Briliant No.1	76.67	-1.39	1.33	1.51	0.65	113.92
24	Zhyoltoye Chudo	71.00	-7.05	4.00	2.82	1.06	112.70
25	Solnyshko	71.33	-6.72	2.33	2.14	0.86	116.22
27	Lunnyy	71.33	-6.72	6.33	3.53	1.39	108.16
28	Zhyoltyy Ranniy	66.33	-11.72	6.33	3.79	1.39	113.16
29	Ganosik	71.67	-6.39	14.33	5.28	2.16	97.48
30	No. 7Zx	79.67	1.61	4.33	2.61	1.19	103.37
31	No. 6	79.67	1.61	4.33	2.61	1.19	103.37
32	No. 5	79.67	1.61	4.33	2.61	1.19	103.37
33	No. 4	79.67	1.61	4.33	2.61	1.19	103.37
34	No. 9	79.67	1.61	4.33	2.61	1.19	103.37
According to the entire sample of 101 samples:							
	X_{med}	78.05	-	-	-	-	-
	X_{min}	64	-11.72	0.33	0.76	-4.12	-6.05
	X_{max}	101	21.95	161.33	17.13	6.24	119.92
	A_m - X_{max} - X_{min}	37	33.67	161.00	16.37	10.36	125.97

Source: *compiled by the authors*

High general adaptive capacity (*GAC*) characterizes genotypes by their ability to provide the maximum level of manifestation of the characteristic. For selection work on early ripening, samples with the shortest vegetation period, i.e., with minimal manifestation of the trait, are of practical value. According to the general adaptive capacity, the samples with the shortest duration of the "seedling–ripening" period were selected – 19 samples (V_i=-11.72...-6.05).

As the most stable genotypes according to the characteristic "duration of the growing season", 32 collection samples with a low value of the specific adaptive capacity (*SAC*) indicator were selected, 23 of which belong to early-ripening. The most stable in terms of specific adaptive capacity (SAC) are the early ripening collection samples – Lyshchyna Kust ($\sigma^2 SAC_i$ – 0.33); Yarylo, Borysfen ($\sigma^2 SAC_i$=1.00); Arb. Kust Lyshchyna, Wm 16, Wm 18, Wm 19, Wm 20, Wm 23, Sladkiy Brilliant ($\sigma^2 SAC_i$=1.33) are consistently early-ripening. 38 samples of different maturity groups had low stability of the characteristic "duration of the vegetation period"; other samples of the collection had average stability.

The main indicator of the stability of the variety is Sg_i – the stability of the genotype. According to many authors, the stability of the variety can be related to the high adaptability of each genotype to various growing conditions (individual buffering). Individual buffering prevails in a genetically homogeneous population. The high stability of the genotype according to the characteristic "duration of the seedling-ripening period" over three years of the study was determined in 31 collection samples, of which 24 samples were early ripening. The most stable were Lyshchyna Kust (Sg_i=0.76); Yarylo (Sg_i=1.28); Borysfen (Sg_i=1.30); Arb. Kust Lyshchyna, Sladkiy Brilliant (Sg_i=1.51); Wm 16, Wm 18, Wm 20 (Sg_i=1.53); Wm 19 (Sg_i=1.63).

According to the results of determining the numerical value of b_i – the coefficient of regression (coefficient of ecological plasticity), according to the length of the growing season, the collection samples of watermelon were divided into three groups – with low, medium, and high ecological plasticity. According to the results of the present study, the early-ripening collection samples Samurai, Snezhok, Rubinovoye Serdtse, Sladkaya Dakota, and the mid-early sample Lypa can be attributed to hybrids of the intensive type with an increased response to growing conditions (b_i=4.23-6.24). According to the study results, 20 collection samples, of which 15 are early ripening, are characterized by an average level of ecological plasticity (b_i=2.21-4.22). The third group, according to the characteristic "duration of the growing season", includes most collection varieties (76%) with an ecological plasticity coefficient from 0.01 to 2.20, which respond to a slight change in growing conditions.

In terms of the selection value of the genotype (SVG_i) according to the characteristic "duration of the seedling-ripening period", 18 collection varieties had high values of the indicator (SVG_i=110.22-119.92), which are valuable for the selection work for early maturity.

Most breeders consider the identification of new sources of valuable stable, plastic traits with a defined rate of reaction to changing growing conditions to be a major area of melon crop research, which allows solving the problem of competitive varieties and hybrids with given parameters. Breeding work on the creation and selection of early-ripening genotypes (lines and hybrids) of watermelon with high adaptive capacity was conducted at the Dnipropetrovsk research station of the Institute of Vegetable and Melon of the National Academy of Agrarian Sciences. The best known method of assessing ecological plasticity and stability of hybrid watermelon populations was used by breeder Z. Sych when creating the Voskhod variety, when hybrid combinations and varieties were evaluated for three years based on the characteristics "fruit mass" and "dry soluble matter content". Then, according to the method of V. Pacudin & L. Lopatyna, calculations were made to determine the parameters of stability and plasticity of this breeding material and the best genotypes were selected. In this study, when selecting valuable forms based on the characteristic "early maturity", the authors also applied the principle of evaluating selection material in changing environmental conditions over the years of study and selected highly adaptive genotypes.

In 2011-2015, station scientists I. Sydorka & V. Zavertaluk investigated nine artificial agrophones and selected lines with a regression coefficient close to one, which were used to create early-ripening highly plastic watermelon hybrids. Analogous studies on the creation of highly adaptive source material were conducted by breeders in the south of Ukraine. Thus, since 2010, adaptive breeding has been introduced at the Southern State Agricultural Station. Breeders of the station created early-ripening varieties: Sotnyk, Spaskyi, Knyazhych, Charivnyk, Portiyniy, and Mandrivnyk F_1 and Ranok F_1 hybrids, which were involved in the present study, but in the conditions of the Ukrainian Forest-Steppe they did not stand out in terms of the level of adaptability.

V. Lymar & O. Kholodnyak (2020) approached the solution of the issue by selecting forms that, due to internal mechanisms, can resist stress and adapt to such conditions without substantial changes in physiological parameters, as well as quickly restore the physiological state by investigating their physiological signs of resistance, which is the main way to improve adaptation in laboratory conditions. The above authors investigated the physiological indicators of stability, namely: the ability of the embryo to start growing under control of the environmental conditions using osmotic solutions. Samples were selected according to precociousness, combining varieties with a close growing season. This was due to differences in the physiological parameters of their seeds. The authors concluded that since the signs of abiotic resistance are formed during the entire ontogenesis, the lines should be assessed and selected for resistance to stress effects not only at the stages of seed germination, but during the vegetation process, which fully corresponds to the present study.

According to O. Shablya & O. Kholodnyak (2021), the parameters of ecological variability of each genotype are vital, since with the growth of the potential productivity of varieties and hybrids, their demand for cultivation technology increases considerably, the dependence of the size and quality of the harvest not only on biotic, but on abiotic factors, increases.

In the conditions of climate change, the cultivation of new highly adaptive varieties and hybrids of the culture is necessary to ensure a sufficient harvest of watermelon. It was the assessment of ecological plasticity and stability of watermelon varieties that allowed Z. Sych (2021) to identify the top watermelon varieties for each region of Ukraine. According to the results of many years of research by R. Vozhehova (2018), methods of selection and creation of new heat-resistant agrochemically effective genotypes of watermelon adapted to cultivation in the conditions of the Steppe zone of Ukraine were established; new varieties of watermelon were created: Tavriiskyi, Snizhok, Krasen, Orfei, Tsilnolystnyi, Spaskyi, Khersonskyi, Kniazhych, Alians, Charivnyk, Mriia, Favoryt, Paralaks, Vohnedar.

Scientists are conducting analogous studies on other melon crops. According to V. Khareba *et al.* (2019), assessment of the ecological plasticity and stability of large-fruited pumpkin varieties according to the main valuable economic indicators in the conditions of the Forest-Steppe of Ukraine with the application of the methodology used in this study allowed selecting a set of varieties for a certain growing zone.

In the conditions of climate change, to ensure a sufficient harvest of watermelon, it is necessary to grow new highly adapted varieties and hybrids of the culture, and therefore analogous studies are conducted by breeders – O. Shablya & O. Kholodnyak (2021), Z. Sych (2021) – to create new varieties and hybrids watermelon in different climatic zones of Ukraine. These authors established that the environmental variability parameters of each watermelon genotype differ depending on the soil and climatic conditions of cultivation. Thus, according to the research of O. Shablya and O. Kholodnyak (2021), the importance of the relevant parameters of the environmental variability of each genotype was proved, since with the growth of the potential productivity of varieties and hybrids, their demand for cultivation technology increases considerably, the dependence of the size and quality of the harvest not only on biotic, but on abiotic factors, increases.

CONCLUSIONS

Based on the results of the assessment, it was found that the group of early-ripening samples was the most numerous, both according to average data and experimental data for individual years. According to average data (X_{med}), 73% of collection samples are classified as early-ripening. 44 samples were picked for selection for early ripening, which during all the years of the study consistently had a period "seedling-maturation" of less than 80 days. The sample was ranked according to the characteristic "duration of the seedling-ripening period", the calculated correlation coefficient of the ranks was ρ=0.69, which, according to the Chaddock scale, indicates a significant correlation. Research has established the limit and amplitude of variation of the signs of the components of the growing season of collection samples. 30 samples with the smallest individual interphase periods were selected for use in selection for early-ripening. According to the general adaptive capacity, the samples with the shortest period "seedling-ripening" were selected – 19 samples (V_i=11.72-6.05). 32 collection samples with a low value of the indicator of specific adaptive capacity were selected, 23 of which belong to early ripening. The high stability of the genotype according to the characteristic "duration of the seedling-ripening period" was determined in 31 collection samples, of which 24 are early-ripening. According to the results of determining the regression coefficient (ecological plasticity coefficient), in terms of the characteristic "duration of the growing season", the collection samples of watermelon were divided into three groups – with low (b_i=0.01-2.20), medium (b_i=2.21-4.22), and high (b_i=4.23-6.24) ecological plasticity. According to the selection value of the genotype according to the characteristic "duration of the seedling-ripening period", 18 collection samples had high indicators (SVG_i=110.22-119.92), which are valuable for use in selection work with watermelon as sources of the characteristic "early ripeness".

The study on the selection of highly adaptive raw material of watermelon based on the trait "early ripeness" helped identify genotypes that correspond to the modelled traits, and their involvement in the selection process to create early-ripening varieties and hybrids with high adaptability will increase the efficiency of selection work in this area; the introduction of new genotypes will extend the period of availability of valuable vitamin products earlier (from 10 days to 20 days earlier), which will contribute to providing the population with healthy nutrients; will increase the amount of cultivation and the yield level of watermelon, which in turn will increase the profitability of production (at least by 20%) and contribute to ensuring food security of Ukraine. This is what determined the relevance of this study and proved the perspective of conducting it on other valuable selection traits that have great economic importance.

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CONFLICT OF INTEREST

The authors of this study declare no conflict of interest.

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Відбір високоадаптивного вихідного матеріалу кавуна для селекції на ранньостиглість

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Анотація. У питанні селекції кавуна залишається актуальною проблема стабільності отримання високої урожайності в умовах прояву абіотичних стресорів зовнішнього середовища. Метою завдання було виділення високоадаптивного вихідного матеріалу кавуна за тривалістю вегетаційного періоду та його складових для використання у селекції на ранньостиглість. Було проаналізовано 101 колекційний зразок кавуна з 9 країн світу. В основу дослідження покладено такі методи: загальнонаукові, вимірювально-вагові, розрахункові, статистичні. Проведено розподіл колекції кавуна на групи стиглості та ранжування вибірки за ознакою «тривалість періоду сходи – достигання». Дослідженнями встановлено амплітуду (A_m) та розмах варіювання *(Lim)* ознак тривалості складових вегетаційного періоду. Для використання в селекції на ранньостиглість виділено зразки з найменшими окремими міжфазними періодами. Визначено: V_i – загальна адаптивна здатність (ЗАЗ), $\sigma 2САЗ_i$ – специфічна адаптивна здатність (САЗ), *Sgi* – стабільність генотипу, b^i – коефіцієнт регресії реакції генотипу на зміну умов (пластичність), $СЦГ_i$ – селекційна цінність генотипу колекції кавуна за ознакою «тривалість вегетаційного періоду». За загальною адаптивною здатністю виділено зразки з найменшою тривалістю періоду «сходи – достигання» – 19 зразків (V_i=-11,72…-6,05). Як найбільш стабільні генотипи за ознакою «тривалість вегетаційного періоду» виділено 32 колекційних сортозразка з низьким значенням показника специфічної адаптивної здатності, 23 з яких відносяться до ранньостиглих. Високу стабільність генотипу (*Sgi*) за ознакою «тривалість періоду сходи – достигання» визначено у 31 колекційного зразка, з яких 24 відносяться до ранньостиглих. За результатами визначення коефіцієнта регресії (коефіцієнта екологічної пластичності), за ознакою тривалість вегетаційного періоду колекційні зразки кавуна було розподіллено на три групи – з низькою (b_i=0,01-2,20), середньою (b_i=2,21-4,22), та високою (b_i=4,23-6,24) екологічною пластичністю. За селекційною цінністю генотипу за ознакою «тривалість періоду сходи – достигання» високі показники мали 18 колекційних зразків ($СЦГ_i$=110,22-119,92), які мають цінність для використання у селекційної роботі з кавуном в якості джерел ознаки «ранньостиглість»

Ключові слова: кавун; селекція; ранньостиглість; адаптивна здатність; стабільність; пластичність; селекційна цінність