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ADAPTIVE POTENTIAL OF A WATERMELON COLLECTION FOR PERFORMANCE INDICATORS

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The adaptive potential of a watermelon collection was evaluated for the following characteristics: total and marketable yield, average marketable fruit weight. The following parameters were calculated: V_i – general adaptive capacity (GAC), $\sigma^2 SAC_i$ – specific adaptive capacity (SAC), Sg_i – genotype stability, bi – regression coefficient of genotype response to changing conditions (plasticity), GBV_i – genotype breeding value. We determined the variation amplitudes and ranges of the performance indicators. The adaptive capacity of the watermelon collection was assessed. For the breeding for certain traits, accessions of practical value, with high GAC, were selected by stability and GBV values. According to the environmental plasticity coefficient (bi), the collection watermelon accessions were ranked as low-, mid- and highly- plastic for different characteristics: intensive accessions with enhanced responses to growing conditions, accessions with medium levels of environmental plasticity and highly-plastic accessions, which slightly respond to changes of growing conditions.

Key words: *watermelon, breeding, collection accession, breeding trait, adaptive capacity, stability, plasticity, breeding value.*

Introduction. The watermelon is the main gourd; according to the FAO's data, watermelons are grown on the total area of about 3,500,000 hectares in 93 countries, with the average yield of about 15 t/ha. In harvest stable yields in the production of any agricultural crop, it is very important to have highly adaptable, plastic, and high-yielding cultivars and hybrids. Through the lens of the current climatic changes, the creation of cultivars and hybrids of domestic plants with high adaptive capacity has become particularly important. The most important objective in breeding is the creation of genotypes that are able to realize their potentials under changing environmental conditions, that is, resistant to biotic and abiotic stressors of the environment, that are able to maximally use resources of the growing area to produce high yields and good-quality products.

In watermelon breeding, the problems of insufficient stability and realization of yield potential, which can be only solved by creating new genotypes with a set of valuable economic characteristics and high adaptive capacity to provide vitamin-rich products, remain urgent.

Literature review and problem articulation. Cultivation of new, highly adapted watermelon cultivars and hybrids guaranteed to harvest sufficient yields [1]. Environmental variability parameters of each genotype are very important, since the higher the yield capacities of cultivars and hybrids, the stricter their requirements to cultivation technologies; the dependence of the yield amount and quality on both biotic and abiotic factors strengthens [2]. Therefore, the identification of new, stable sources of valuable traits, with specified norms of reactions to changes in growing conditions, is a very important trend in gourd studies, which allows solving the problem of competitive cultivars and hybrids with desirable parameters [3].

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Availability of specialized starting material makes it possible to create productive, abiotically- and biotically-resistant watermelon cultivars and hybrids with fruits of excellent palatability [2]. Comprehensive assessments of the existing gene pool allow breeders to select starting material (accessions with valuable economic characteristics) for further breeding.

Valuable genetic sources are the country's wealth and asset; thanks to them, we are able to compete with foreign breeding organizations in the creation of new cultivars and hybrids of agricultural crops. The global gene pool of watermelon collections is known to be the most valuable source for the development of new, high-yielding genotypes combining resistance to biotic and abiotic factors of the environment with other economically valuable characteristics [4]. Studies of the global genetic potential of the watermelon, complex approaches to identification of stable sources of various traits, and their involvement in hybridization with subsequent application of analytical breeding methods ensure the creation of diverse starting material and its fruitful use in the varietal and heterosis breeding of this crop [5, 6, 7].

One can select highly adaptive starting material, basing on comprehensive assessments with determination of the environmental variability parameters of genotypes. The following parameters are used: general adaptive capacity (*GAC*), specific adaptive capacity (*SAC*), genotype stability (Sg_i), and genotype breeding value (GBV_i). The response of a genotype to changes in environmental conditions is assessed through the coefficient of environmental plasticity (*bi*), which reflects the plasticity and stability of an accession related to the mean response to changing environmental conditions in research years across all studied forms. The greater *bi* is, the steeper the regression line is, and the more susceptible to changes in growing conditions this accession is. Most researchers determine the coefficient of environmental plasticity by the traditional method, using regression analysis [8, 9]. Genotypes with the plasticity coefficient close to one ($b_i = 1 \pm 1\sigma$) were considered as relatively stable accessions, which have optimal responses to environmental conditions, at the average population level. High values of the coefficient of environmental plasticity ($b_i > 1 \pm 1\sigma$) indicate strong responses of genotypes to changes in environmental conditions. Such accessions only realize their genetic potentials under certain comfortable conditions, that is, they have narrow norms of reactions. Accessions with below-zero coefficients of environmental plasticity also demonstrate significant responses to changes in environmental conditions, like the previous group, but of the opposite vector. Specific responses to external conditions in these genotypes differ from those in the vast majority of the studied sample. Special attention is paid to evaluation of the plasticity of different traits, their peculiarities under changing growing conditions [10, 11].

Hence, our study was designed to determine the adaptive potential of the collection of watermelon hybrids for their further use in breeding.

To select highly adaptable watermelon starting material by the main indicators of the performance (yield and average marketable fruit weight).

Materials and methods. The watermelon collection was investigated: 101 cultivars and lines from 9 countries (55 accessions from Ukraine, 23 – from Russia, 8 – from China, 5 – from the USA, 3 – from Moldova, 2 – from Kazakhstan, Thailand and the Czech Republic each, and 1 – from Italy). A Ukrainian cultivar, Maks Plus, was taken as the check accession.

The experiments were carried out in the research-breeding crop rotation fields of the Institute of Vegetable and Melon Growing of NAAS located in the Left-Bank Forest-Steppe of Ukraine (central mid-wetted area of the Kharkivskyi District of the Kharkivska Oblast) in 2018–2020. The climate of the test location is temperate-continental. The experiments were carried out in open ground against natural infectious background. The record plot area was 19.6 m^2. The following parameters were calculated: 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), and GBV_i – genotype breeding value. The study was conducted in accordance with traditional methods [12, 13, 14, 15]. AV Kilchevskyi and LV Khotylyova's method was applied to estimate the parameters of adaptive capacity and stability of the genotypes [16]. The environmental plasticity coefficients (b_i) were calculated according to SA Eberhart and WA Russel algorithm [17]. Data were statistically processed, as BA Dospekhov recommended [8], in the Statistica software. The watermelon growing technologies complied with routine technologies for this soil-climate zone [13, 18].

Results and Discussion. The adaptive potential of the watermelon collection was evaluated for the following characteristics: total yield, marketable yield, and average marketable fruit weight.

From the averaged three-year data on the collection, we established that the variation amplitude (Am) of the "total yield" trait was 51.26; the variation range was 15.07–66.33 t/ha. In the check accession (Maks Plus), the average total yield across 3 years was 64.72 t/ha. Thirty-one collection accessions were selected by the "total yield" trait for further work.

Accessions with high *GAC*, which characterizes genotypes by their ability to demonstrate the maximum expression of a trait, are of practical value for breeding for total yield. Two accessions, Bochka Medu, 108099 (V_i= 25.27) and Karapuz, 108109 (V_i= 24.59) were distinguished due to high GAC values.

Eleven collection accessions with low SAC values were selected as the most stable genotypes in terms of the "total yield" trait. By SAC, Orfei, 108141 ($\sigma^2 SAC_i$ = 0.15), Bochka Medu, 108099 ($\sigma^2 SAC_i$= 1.49) and No. 545 ($\sigma^2 SAC_i$= 1.37) with consistently high total yields and Snezhok "Sadyba" ($\sigma^2 SAC_i$= 0.51), Lypa ($\sigma^2 SAC_i$= 0.27) and Lezheboka Medovyi, 108116 ($\sigma^2 SAC_i$= 0.61) stably giving moderate total yields were selected. The other five accessions produced stable but low yields. The SAC of the check accession (Maks Plus) was medium ($\sigma^2 SAC_i$= 13.37) (Table 1).

The main indicator of the stability of a cultivar is the genotype stability (Sg_i). As many authors believe [9, 19], the stability of a cultivar can be related to the high adaptability of each genotype to various growing conditions (individual buffering). Individual buffering prevails in a genetically homogeneous population. High values of the genotype stability (higher than that of the check accession) for the "total yield" trait across the 3 study years were recorded in 32 collection accessions. Eighteen accessions gave stable total yields (over 45 t/ha): Kniazhych, Sladkaya Dakota, Snezhok, No. 545, Lypa, Samurai, Kholodok, Roial Madzhestik (2), Alians, Bochka Medu, Karapuz, Orfei, A-14 Tur, Minimeloni, Roial Madzhestik, No 7Zx, No 9, and Monomakh (Sg_i= 1.07 - 5.26 %).

Based on the regression coefficient (the coefficient of environmental plasticity, *bi*) for the "total yield" trait, the collection watermelon accessions were divided into three groups: with low, medium and high environmental plasticity. From the collection, 26 accessions, which we can class as intensive cultivars with enhanced responses to growing conditions (b_i= 1.51–3.32), were selected. Most of the collection (50 accessions) is characterized by moderate environmental plasticity (b_i= 0.51–1.50). Group 3 comprises accessions that slightly respond to changes in growing conditions in terms of the total yield, with the environmental plasticity coefficient of 0.01–0.50. This group includes such high-yielding accessions as No. 545, Kholodok, Bochka Medu, Karapuz, and Orfei yielding over 50 t/ha.

As to the GBV for the "total yield" trait, 15 collection accessions had high values. The accessions with GBV higher than that of the check accession were No. 545, Samurai, Kholodok, Bochka Medu, Karapuz, Orfei, A-14 Tur, and Minimeloni (GBV_i= 47.51–60.53).

Table 1

Environmental variability parameters of the collection watermelon accessions selected by adaptability in terms of the "total yield" trait, mean for 2018–2020

Serial number	Collection accession	Total yield, t/ha					
		Mean across the years ($\bar{x}$)	V_i	$\sigma^2 SAC_i$	$Sg_{i,\%}$	b_i	GBV_i
1	Maks Plus (check accession)	64.72	23.66	13.37	5.65	1.03	47.37
2	Rubinovoye Serdtse	32.74	-8.32	1.51	3.75	0.32	26.92
3	Kniazhych	46.41	5.35	2.36	3.31	0.53	39.12
4	Khersonskiye Ogni	24.51	-16.55	0.62	3.21	0.26	20.78
5	SladkayaDakota	55.94	14.88	7.89	5.02	0.94	42.61
6	Snezhok	52.49	11.43	2.50	3.01	0.54	44.98
7	Snezhok "Sadyba"	42.95	1.89	0.51	1.66	0.18	39.56
8	No545	57.86	16.80	1.37	2.02	0.38	52.30
9	Lad	62.29	21.23	18.72	6.95	1.19	41.76
10	Lypa	49.11	8.05	0.27	1.07	0.18	46.62
11	Sontsedar	33.69	-7.37	1.95	4.15	0.30	27.06
12	Samurai	58.27	17.21	4.95	3.82	0.75	47.71
13	Kholodok	56.14	15.08	2.58	2.86	0.44	48.53
14	Tselnolistnyy	36.40	-4.66	2.77	4.57	-0.29	28.50
15	Yarylo (Fliura Market)	41.51	0.45	2.99	4.17	-0.09	33.31
16	Roial Madzhestik (2)	59.22	18.16	8.83	5.02	0.99	45.12
17	Kytai No6	31.59	-9.47	0.88	2.96	0.30	27.14
18	Kytai No3	42.78	1.72	2.53	3.72	-0.16	35.23
19	Kakhovskyi	26.19	-14.87	0.45	2.56	0.22	23.01
20	Alians	46.69	5.63	3.37	3.93	0.57	37.98
21	Bochka Medu,	66.33	25.27	1.49	1.84	0.35	60.53
22	Karapuz	65.65	24.59	2.20	2.26	0.36	58.62
23	Lezheboka Medovyi	44.88	3.82	0.61	1.74	0.27	41.18
24	Orfei	61.28	20.22	0.15	0.63	0.01	59.44
25	Semyk	44.61	3.55	5.63	5.32	0.82	33.35
26	A-14 Tur	59.99	18.93	6.91	4.38	0.82	47.51
27	Minimeloni	64.47	23.41	6.15	3.85	0.86	52.70
28	Roial Madzhestik	47.39	6.35	5.99	5.16	0.84	35.80
29	No 7Zx	48.47	7.41	6.15	5.12	0.86	36.70
30	No 9	51.64	10.52	6.48	4.94	0.88	39.50
31	Monomakh	46.94	5.89	6.09	5.26	0.85	35.24
For the entire sample (101 accessions):							
	X_{min}	15.07	-26.01	0.15	0.63	-1.42	-13.30
	X_{max}	66.33	25.27	181.72	29.72	3.32	60.53
	$A_m - X_{max} - X_{min}$	51.26	51.28	181.57	29.09	4.74	73.83

The adaptability parameters of the collection watermelon accessions for the "marketable yield" trait differed slightly from those for the “total yield” trait (Table 2). Based on the averaged three-year data, the variation amplitude (Am) of the "marketable yield" trait was 51.15 t/ha; the variation range of this trait was 13.19–64.34 t/ha.

In the check cultivar, Maks Plus, the marketable yield across the 3 years was high (63.80 t/ha), and only one cultivar, Karapuz, with the yield of 64.34 t/ha, exceeded it. Karapuz also statistically significantly exceeded the check accession in terms of the *GAC* (V_i = 26.12). Karapuz showed high GAC, higher than the check accession, both for the total and marketable yields.

By the *SAC* for the "marketable yield" trait, the most stable fourteen collection accessions were selected: Samurai ($\sigma^2 SAC_i$= 1.20), Bochka Medu ($\sigma^2 SAC_i$= 2.01), Minimeloni ($\sigma^2 SAC_i$= 0.78

), and No 9 (σ^2SAC_i= 1.75) with consistently high marketable yields; Kniazhych (σ^2SAC_i= 1.00), Snezhok "Sadyba" (σ^2SAC_i= 1.45), Alians (σ^2SAC_i= 0.65), Roial Madzhestik (σ2CACi–2.01), No 7Zx (σ^2SAC_i= 2.03), and Foton (σ^2SAC_i= 0.67) giving stable moderate marketable yields. The other stable accessions were low-yielding.

Over the 3 study years, the genotype stability (Sg_i) higher than that of the check accession for the "marketable yield" trait was recorded in 22 collection accessions; of them, eleven accessions yielded more than 45 t/ha: Snezhok, Snezhok "Sadyba", Samurai, Roial Madzhestik (2), Bochka Medu, Karapuz, A-14 Tur, Minimeloni, No 7Zx, and No 9 (Sg_i= 1.64–4.77%).

Table 2

Environmental variability parameters of the collection watermelon accessions selected by adaptability in terms of the "marketable yield" trait, mean for 2018–2020

Serial number	Collection accession	Marketable yield, t/ha					
		Mean across the years ($\bar{x}$)	V_i	σ^2SAC_i	$Sg_{i,\ \%}$	b_i	GBV_i
1	Maks Plus (check accession)	63.80	25.57	10.51	5.08	1.34	49.80
2	Rubinovoye Serdtse	30.89	-7.34	0.70	2.71	0.34	27.27
3	Kniazhych	44.18	5.95	1.00	2.26	-0.07	39.87
4	SladkayaDakota	55.43	17.20	11.13	6.02	1.56	41.03
5	Snezhok	49.66	11.44	2.96	3.47	0.80	42.23
6	Snezhok "Sadyba"	40.97	2.75	1.45	2.93	0.04	35.78
7	Samurai	57.38	19.16	1.20	1.91	0.39	52.65
8	Roial Madzhestik (2), 108146	56.40	18.17	7.24	4.77	1.10	44.78
9	Alians, 108089	42.43	4.21	0.65	1.89	-0.41	38.97
10	Foton, 108096	41.30	3.07	0.67	1.98	-0.15	37.77
11	Bochka Medu, 108099	63.45	25.22	2.01	2.23	0.46	57.33
12	Karapuz, 108109	64.34	26.12	4.07	3.13	0.88	55.64
13	Lezheboka Medovyi, 108116	43.99	5.76	2.31	3.46	0.54	37.42
14	Orfei, 108141	59.35	21.13	11.19	5.64	0.65	44.92
15	Semyk	43.73	5.50	2.16	3.36	0.74	37.39
16	A-14 Tur	56.93	18.70	3.08	3.08	0.71	49.35
17	Minimeloni, 108104	54.06	15.83	0.78	1.64	0.43	50.24
18	Roial Madzhestik, 108144	44.29	6.06	2.01	3.20	0.71	38.17
19	Zhyzel, 107616	33.42	-4.81	1.22	3.31	0.56	28.64
20	No 7Zx,108154	45.80	7.58	2.03	3.11	0.72	39.66
21	No 9,108178	47.90	9.67	1.75	2.76	0.67	42.19
22	Monomakh, 108103	46.59	8.36	3.56	4.05	0.94	38.45
For the entire sample (101 accessions):							
	X_{min}	13.19	-25.03	0.65	1.64	-2.38	-15.76
	X_{max}	64.34	26.12	212.71	31.89	4.65	57.33
	$A_m = X_{max} - X_{min}$	51.15	51.15	212.04	30.25	7.03	73.09

By the environmental plasticity coefficient (regression coefficient *bi*) for the "marketable yield" trait, the collection watermelon accessions were divided into three groups: with low, medium and high environmental plasticity. Forty accessions were classed as intensive ones with enhanced responses to growing conditions (b_i = 1.51–4.65). Most of the accessions in the collection (46) were characterized by moderate environmental plasticity (b_i = 0.51–1.50). Group 3 consisted of 15 accessions that slightly responded to changes in growing conditions in terms of the marketable yield, having the environmental plasticity coefficient of 0.10–0.50. These accessions included high-yielding Minimeloni, Bochka Medu and Samurai.

Samurai, Bochka Medu, Karapuz, and Minimeloni had high values of the GBV for the "marketable yield" trait, like for the total yield, higher than that of the check accession (GBV_i = 52.65, 57.33, 55.64, and 50.24, respectively).

From the averaged three-year data on the watermelon accessions, the variation amplitude of the "average marketable fruit weight" trait was 3.0 kg. The variation range of this trait was 0.99–3.99 kg. The average fruit weight in the sample across the 3 years was 2.14 kg. In the check cultivar, Maks Plus, the average fruit weight was 2.50 kg.

For the breeding for large weight of fruit, 14 collection accessions had the GAC statistically significantly higher (V_i= 0.40–1.82) than that in the check accession.

In half of the accessions in the collection, the SAC values for the "average marketable fruit weight" trait were quite low ($\sigma^2 SAC_i$= 0.01–0.02), indicating stability of the trait. Another indicator of the stability of a cultivar is the genotype stability (Sg_i). High values of the genotype stability (higher than that in the check accession) for the "average marketable fruit weight" were recorded in 50 accessions of the collection across the 3 study years; at that, 29 of them consistently produced small fruits, 16 – medium-sized fruits and only 6 accessions consistently yielded large fruits (Table 3).

Table 3

Environmental variability parameters of the collection watermelon accessions selected by adaptability in terms of the "the average marketable fruit weight" trait, mean for 2018–2020

Serial number	Collection accession	Average marketable fruit weight, kg					
		Mean across the years ($\bar{x}$)	V_i	$\sigma^2 SAC_i$	$Sg_{i,\%}$	b_i	GBV_i
1	Maks Plus (check accession)	2.50	0.35	0.04	7.54	-2.37	1.65
2	Samurai	3.04	0.89	0.07	8.49	5.56	1.88
3	Atamanskyi, 108114	2.17	0.02	0.01	2.97	0.96	1.88
4	ThailandNo 2, 108152	2.39	0.25	0.01	4.12	0.17	1.95
5	Medok, 108086	2.35	0.21	0.01	1.84	0.48	2.16
6	Asar, 108087	2.20	0.06	0.01	3.10	0.98	1.90
7	Yarylo (Fliura Market)	2.13	-0.01	0.01	1.74	0.78	1.97
8	Kytai No3	2.46	0.31	0.01	3.16	0.28	2.11
9	Alians	2.50	0.36	0.02	4.85	1.27	1.96
10	Foton	2.24	0.10	0.01	4.20	1.12	1.82
11	Rafinad	2.29	0.15	0.01	3.91	0.21	1.89
12	Semyk	2.14	-0.01	0.01	1.75	0.91	1.97
13	A-14 Tur	2.57	0.43	0.01	1.90	1.18	2.35
14	Wm 14	2.37	0.23	0.01	3.25	1.76	2.03
15	Wm 16	2.29	0.15	0.01	4.56	2.28	1.82
16	Wm 20	2.43	0.29	0.02	6.02	3.05	1.77
17	Wm 23	3.11	0.97	0.03	5.67	3.60	2.32
18	Solnyshko	2.99	0.82	0.01	1.95	1.38	2.71
19	Podarok Solntsa	3.99	1.82	0.01	1.46	1.38	3.71
20	Minimeloni	2.20	0.07	0.01	0.74	0.37	2.14
21	Roial Madzhestik	2.69	0.52	0.01	2.17	1.38	2.41
22	No7Zx	2.64	0.50	0.01	1.52	0.98	2.46
23	No5	2.11	-0.02	0.01	1.05	0.53	2.02
24	No9	2.10	-0.03	0.01	0.73	0.34	2.04
25	Monomakh	2.72	0.58	0.02	0.93	0.61	2,61
26	Svitoranok	2.26	0.11	0.01	2.08	1.15	2,04
For the entire sample (101 accessions):							
	X_{min}	0.99	-1.18	0.01	0.73	-12.44	-1.94
	X_{max}	3.99	1.82	0.79	45.70	20.11	3.71
	$A_m - X_{max} - X_{min}$	3.00	3.00	0.78	44.97	32.55	5.65

By the regression coefficient b_i (environmental plasticity coefficient) for the "average marketable fruit weight" trait, the collection watermelon accessions were categorized as low-, mid- and highly plastic. Forty-three collection accessions can be referred to as accessions with enhanced responses of the "average marketable fruit weight" trait to growing conditions (b_i>2.05). Forty-four collection accessions were characterized by moderate environmental plasticity for the "average marketable fruit weight" trait. Group 3 comprised 14 accessions (with the environmental plasticity coefficient of 0.08–0.48) that slightly responded to changes in growing conditions in terms of the "average marketable fruit weight" trait.

Thirty-one collection accessions had high values of the GBV (GBV_i= 1.73–3.71) for the "average marketable fruit weight" trait, while the check accession, Maks Plus, had $GBV_i$of 1.65. The environmental variability parameters of the watermelon collection for the "average marketable fruit weight" trait are summarized in Table 3.

Conclusions. The adaptive capacity of the watermelon collection was determined. For the breeding for different traits, accessions with high values of the GAC are of practical value. Hence, we selected 2 collection accessions by total yield, 1 accession by marketable yield, and 14 accessions by average marketable fruit weight. By the stability indicators, we selected 18 genotypes with consistently high or medium total yields, 11 accessions that consistently gave high marketable yields, and accessions with stable average marketable fruit weight (29 accessions with small fruits, 16 with mid-sized fruits, and 6 with large fruits). By the regression coefficient b_i(environmental plasticity coefficient), the collection watermelon accessions were categorized as low-, mid- and highly plastic for the characteristics under investigation. Intensive accessions with enhanced responses to growing conditions totaled as follows: 26 accessions strongly responded in terms of the total yield, 40 – in terms of the marketable yield, and 43 – in terms of the average marketable fruit weight. Accessions with medium levels of environmental plasticity totaled as follows: 50 accessions moderately responded in terms of the total yield, 46 – in terms of the marketable yield, and 44 – in terms of the average marketable fruit weight. Highly plastic accessions, which slightly react to changes in growing conditions, totaled as follows: 25 accessions weakly responded in terms of the total yield, 15 – in terms of the marketable yield, and 14 – in terms of the average marketable fruit weight. By the GBV, 15 collection accessions were selected because of the “total yield” trait, 4 – because of the “marketable yield” trait, and 13 – because of the “average marketable fruit weight” trait.

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ADAPTIVE POTENTIAL OF A WATERMELON COLLECTION FOR PERFORMANCE INDICATORS

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Purpose and Objectives. To select highly adaptable watermelon starting material by the main indicators of the performance (yield and average marketable fruit weight).

Materials and Methods. The watermelon collection was investigated: 101 cultivars and lines from 9 countries (55 accessions from Ukraine, 23 – from Russia, 8 – from China, 5 – from the USA, 3 – from Moldova, 2 – from Kazakhstan, Thailand and the Czech Republic each, and 1 –

from Italy). A Ukrainian cultivar, Maks Plus, was taken as the check accession. The following parameters were calculated: 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), and GBV_i – genotype breeding value. AV Kilchevskyi and LV Khotylyova's method was applied to estimate the parameters of adaptive capacity and stability of the genotypes. The environmental plasticity coefficients (b_i) were calculated according to SA Eberhart and WA Russel algorithm. Data were statistically processed, as BA Dospekhov recommended.

Results and Discussion. The adaptive potential of the watermelon collection was evaluated for the following traits: total yield, marketable yield, and average marketable fruit weight. The variation amplitude (A_m) of the "total yield" trait based on the averaged three-year data on the collection was 51.26; the variation range was 15.07–66.33 t/ha. In the check accession, Maks Plus, the mean total yield across the 3 years was 64.72 t/ha. For further work, we selected 31 collection accessions, basing on the total yield" trait. The adaptability parameters of the collection watermelon accessions for the "marketable yield" trait differed somewhat from those for the "total yield" trait. From the averaged three-year data, the variation amplitude (A_m) of the "marketable yield" trait was 51.15 t/ha; the variation range of this trait was 13.19–64.34 t/ha. The variation amplitude of the "average marketable fruit weight" trait based on the averaged three-year data was 3.00 kg. The variation range of this trait was 0.99–3.99 kg. The average fruit weight in the sample across the 3 years was 2.14 kg. In the check cultivar, Maks Plus, the average fruit weight was 2.50 kg. For the breeding for the characteristics under investigation, accessions of practical value, with high values of the general adaptive capacity, stability, and genotype breeding value were selected. By the environmental plasticity coefficient b_i, the collection watermelon accessions were categorized as low-, mid- and highly plastic in terms of the characteristics under investigation: intensive accessions with enhanced responses to growing conditions, accessions with moderate levels of the environmental plasticity, and highly plastic accessions, which slightly respond to changes in growing conditions.

Conclusions. For selection work on various traits, samples with high general adaptive capacity (GAP) are of practical value, selected: 2 collection samples (by total yield), 1 (by marketable yield), 14 (by average mass of marketable fruit). According to stability indicators, 18 genotypes with consistently high and average total yield were selected; 11 – consistently high commodity productivity; stable average weight of marketable fruit – 29 (small fruits), 16 (medium fruits), 6 (large fruits). According to the coefficient of ecological plasticity *bi*, the collection samples of watermelon were divided into low, medium and high ecological plasticity according to various characteristics. Samples of the intensive type with an increased reaction to growing conditions: in terms of total productivity – 26; by commercial productivity – 40; according to the average weight of marketable fruit – 43 samples. Samples with an average level of ecological plasticity: by total productivity – 50; by commercial productivity – 46; according to the average weight of marketable fruit – 44 samples. Highly plastic, which to a small extent react to changes in growing conditions: in terms of total yield – 25; by commercial productivity – 15; according to the average weight of marketable fruit – 14 collection samples. According to the breeding value of the genotype (*SVG*), 15 samples were selected according to the trait of total productivity; according to the sign, the marketable yield of 4 samples; according to the sign, the average mass of marketable fruit is 31 collection samples.

Key words: *watermelon, selection, collection sample, selection feature, adaptive capacity, stability, plasticity, selection value.*

АДАПТИВНИЙ ПОТЕНЦІАЛ КОЛЕКЦІЇ КАВУНА ЗА ПРОДУКТИВНИМИ ПОКАЗНИКАМИ

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Мета і задачі дослідження. Виділити високо адаптивний вихідний матеріал кавуна за основними продуктивними показниками (урожайністю, середньою масою товарного плоду).

Матеріали та методи. Об’єкт досліджень:колекційні зразки кавуна - 101 сорти та лінії з 9 країн світу (55 зразків з України, 23 з Росії, 8 з Китаю, 5 з США, 3 з Молдови, по 2 з Казахстану, Тайланду і Чехії, 1 з Італії). Стандарт – сорт Макс плюс (Україна). Було визначено: V_i - загальну адаптивну здатність (*ЗАЗ*), $\sigma^2 CAC_i$ – специфічну адаптивну здатність (*САЗ*), Sg_i – стабільність генотипу, b_i - коефіцієнт регресії реакції генотипу на зміну умов (пластичність), $СЦГ_i$ – селекційну цінність генотипу. Для оцінки параметрів адаптивної здатності та стабільності генотипів використано методику А.В. Кільчевського, Л.В. Хотильової. Коефіцієнти екологічної пластичності b_iрозраховано згідно з методикою S.A. Eberhart, W.A. Russel. Статистичне оброблення результатів досліджень виконували за методиками, описаними Б.А. Доспєховим.

Обговорення результатів. Проведено вивчення адаптивного потенціалу колекції кавуна за ознаками: «загальна урожайність», «товарна урожайність», «середня маса товарного плоду». Дослідженнями було встановлено, що амплітуда варіювання (A_m) ознаки «загальна урожайність» за усередненими трьох річними даними вивчення колекції становила 51,26, розмах варіювання – 15,07–66,33 т/га. У стандарту Макс плюс середня загальна урожайність за 3 роки була 64,72 т/га. Для подальшої роботи за ознакою «загальна урожайність» відібрано 31 колекційний зразок. Адаптивні властивості колекційних зразків кавуна за ознакою «товарна урожайність» декілька відрізнялися від показників за ознакою «загальна урожайність». Амплітуда варіювання ознаки «товарна урожайність» (A_m) за усередненими трирічними даними становила 51,15 т/га, розмах варіювання ознаки - 13,19 – 64, 34 т/га. За результатами досліджень амплітуда варіювання ознаки «середня маса товарного плоду» за усередненими трьохрічними даними вивчення гібридних зразків становила 3,00 кг. Розмах варіювання даної ознаки становив 0,99–3,99 кг. Середня маса плоду по вибірки за три роки була 2,14 кг. У сорту-стандарту Макс плюс показник «середня маса плоду» дорівнював 2,50 кг. Для селекційної роботи на різні ознаки виділено зразки, які мають практичну цінність з високою загальною адаптивною здатністю, за показниками стабільності, за селекційною цінністю генотипу (СЦГі). За коефіцієнтом екологічної пластичності *bi*, колекційні зразки кавуна було розподілено на низько-, середньо- та високопластичні за різними ознаками: зразки інтенсивного типу зі збільшеною реакцією на умови вирощування, зразки зі середнім рівнем екологічної пластичності та високо пластичні, які в незначній мірі реагують на зміну умов вирощування.

Висновки. Визначено адаптивну здатність колекції кавуна. Для селекційної роботи на різні ознаки практичну цінність становлять зразки з високою загальною адаптивною здатністю (*ЗАЗ*), виділено: два колекційних зразки (за загальною врожайністю), 1 (за товарною урожайністю), 14 (за середньою масою товарного плоду). За показниками стабільності виділено 18 генотипів зі стабільно високою та середньою загальною урожайністю; 11 – стабільно висока товарна врожайність; стабільна середня маса товарного плоду – 29 (дрібні плоди), 16 (плоди середні), шість (великі плоди). За коефіцієнтом регресії (коефіцієнтом екологічної пластичності) b_i, колекційні зразки кавуна було розподіллено на низько, середньо та високо екологічно пластичні за різними ознаками. Зразки інтенсивного типу зі збільшеною реакцією на умови вирощування: за загальною урожайністю – 26; за товарною врожайністю – 40; за середньою масою товарного плоду – 43 зразка. Зразки зі середнім рівнем екологічної пластичності: за загальною урожайністю – 50; за товарною врожайністю – 46; за середньою масою товарного плоду – 44 зразків. Високо пластичні, які незначно реагують на зміну умов вирощування: за загальною урожайністю – 25; за товарною урожайністю –15; за середньою масою товарного плоду – 14 колекційних зразків. За селекційною цінністю генотипу (*СЦГі*) виділено: за ознакою загальна врожайність 15 зразків; за ознакою товарна врожайність чотири зразки; за ознакою середня маса товарного плоду – 31 колекційний зразок.

Ключові слова: *кавун, селекція, колекційній зразок, селекційна ознака, адаптивна здатність, стабільність, пластичність, селекційна цінність.*

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INHERITANCE OF SPIKE PRODUCTIVITY ELEMENTS IN F_1 WINTER BREAD WHEAT HYBRIDS

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In 2018–2020, the Plant Production Institute named after V.Ya. Yuriev of NAAS evaluated the inheritance of spike productivity elements in winter bread wheat for dominance degree (hct). In F_1 hybrids during the study years, the prevailing type of inheritance of all the studied traits was overdominance, specifically for the spike length (50%, 95% and 75% in 2018, 2019 and 2020, respectively), the spikelet number per spike (85% in 2018 and 2020 and 100% 2019), the kernel number per spike (70% in 2018, 95% in 2019 and 55% in 2020), the kernel weight per spike (75% in 2018, 100% in 2019 and 95% in 2020), and the thousand kernel weight (70% in 2018 and 2020, 75% in 2019).

Keywords: *winter bread wheat, inheritance (hct), spike productivity elements, combination, overdominance*

Introduction. Increasing yield is the mainstream of winter wheat breeding. The creation of wheat varieties with the highest possible yield capacity is the ultimate goal of every breeder, as its increase is one of the most important objectives and this objective is very difficult and complex [1]. In its turn, the yield capacity is determined primarily by spike productivity and productive stem density.

To create high-yielding varieties, it is necessary to have starting material with several valuable characteristics. At the early stages of breeding, it is important to predict how hybrids

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