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EVALUATION OF DROUGHT RESISTANCE OF SOFT WHEAT (*Triticum aestivum* L.) GENOTYPES IN FIELD CONDITIONS BY TURGOROMETRIC METHOD

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ОЦЕНКА ЗАСУХОУСТОЙЧИВОСТИ ГЕНОТИПОВ МЯГКОЙ ПШЕНИЦЫ (*Triticum aestivum* L.) В ПОЛЕВЫХ УСЛОВИЯХ ТУРГОРОМЕТРИЧЕСКИМ МЕТОДОМ

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Abstract. In the research work, 32 were local (materials of the "Cereals and Legumes" Department of the Institute of Genetic Resources of ANAS) and 25 were introduced by CIMMYT (International Center for Maize and Wheat Improvement), a total of 57 (*Triticum aestivum* L.) studied the effect of stress factors on physiological processes of autumn soft wheat genotypes under field conditions, especially drought on the water retention capacity of leaves. Water retention capacity is considered as a very valuable trait of wheat genotypes and is evaluated as resistance to drought stress. As a result of the study, among 57 wheat genotypes, the following genotypes were classified as I-drought resistant (Gobustan (st.) (AZE), Bol wheat (AZE), Grekum75/50 (AZE), Taraggi (AZE), Akinchi84 (AZE), Giymetli 2/ 17(AZE), Sheki 1(AZE), Tale38 (AZE),TX96V2847(US-TX), Arlin/Yuma (USA-KSU), MV Dalma (HU-MV), Desin (RO-FL), Duopebusa (MOL), SG-S1915 (CZ), U1254-7-9-2-1/TX86A5616//Rina-6)(TCI), II- moderately resistant to drought (Arzu (AZE), Zardabi (AZE), Durdane (AZE), Mirbashir128 (AZE), Nurlu99 (AZE), Ruzi84 (AZE), Aran (AZE), Murov2(AZE), GobustanS2 (AZE), Starshina (RUS-KR), MV06-02 (HU-MV), Gerek (TR- ESK), Gloria (RO-FL), Bezostaya1(TR-ESK), LC924/Petja (BG-SAD), Sonmez (TR-ESK), Dalnitskaya (UKR)) and III- drought (Birlik (AZE), Gurgane 1 (AZE), Karabakh10 (AZE), Parzivan 1(AZE), Parzivan 2(AZE), Azeri (AZE), Saba (AZE), Zubkov (KYR), Steklovidnaya 24 (KAZ)) are grouped as sensitive.

Аннотация. Рассмотрены 32 местных (материалы Института генетических ресурсов НАН Азербайджана) и 25 интродуцентов CIMMYT (Международный центр улучшения кукурузы и пшеницы), всего — 57 (*Triticum aestivum* L.) изучали влияние стрессовых факторов на физиологические процессы генотипов озимой мягкой пшеницы в полевых условиях, особенно засухи, на водоудерживающую способность листьев. Водоудерживающая способность считается очень ценным признаком генотипов пшеницы и оценивается как устойчивость к засушливому стрессу. В результате исследования среди 57 генотипов пшеницы к I — засухоустойчивым отнесены следующие генотипы (Гобустан (ст.) (АЗЕ), пшеница Бол (АЗЕ), Грекум 75/50 (АЗЕ), Тарагги (АЗЕ), Акинчи 84 (AZE), Гийметли 2/17 (AZE), Шеки 1 (AZE), Tale 38 (AZE),TX96V2847 (US-TX), Arlin/Yuma (USA-KSU), MV Dalma (HU-MV), Desin (RO-FL), Duopebusa (MOL), SG-S1915 (CZ), U1254-7-9-2-1/TX86A5616//Rina-6) (TCI), II — среднеустойчивый к засухе (Arzu (AZE), Зардаби (АЗЕ), Дурдане (АЗЕ), Мирбашир128 (АЗЕ), Нурлу99 (АЗЕ), Рузи84 (АЗЕ), Аран (АЗЕ), Муров2(АЗЕ), ГобустанС2 (АЗЕ), Старшина (РУС-КР), МВ06-02 (HU-MV), Герек (TR-ESK), Глория (RO-FL), Безостая1(TR-ESK), LC924/Petja (BG-SAD), Sonmez (TR-ESK), Дальницкая (UKR)) и III — засуха (Бирлик (АЗЕ), Гургане 1

(АЗЕ), Карабах10 (АЗЕ), Парзиван 1(АЗЕ), Парзиван 2(АЗЕ), Азери (АЗЕ), Саба (АЗЕ), Зубков (КЫР), Стекловидная 24 (КАЗ))) сгруппированы как чувствительные.

Keywords: soft wheat, water, stress, drought.

Ключевые слова: мягкая пшеница, вода, стресс, засуха.

In modern times, the production of high-quality wheat grain in the world, including in the republic, is an important problem of great importance in ensuring food security. Ensuring food security in every state is an integral part of its economic and national security, and it is one of the socio-economic issues that are important for the state and must be solved [8].

One of the priority directions in the protection of human health in Azerbaijan is the issue of ensuring food safety in the republic, taking into account the fact that these issues are of great importance from the point of view of life and the problems are of a global nature, new concepts have been developed in this direction and special attention has been paid to conducting extensive scientific research [1]. Many countries of the world, including Azerbaijan, are considered to be one of the oldest centers of wheat, and the number of cereal plants in the mountains of the Greater and Lesser Caucasus ranges is greater, of which 14 of the 22 known types of wheat have been identified in Azerbaijan [2]. In recent years, against the background of global climate change, which regularly occurs on our planet, the relative decrease in the quantitative and qualitative indicators of a number of cultivated plants, including wheat, has resulted in a decrease in productivity [7].

Drought, included in the abiotic stress factors, has been the most important stress factor causing the most economic losses, slowing down the growth and development of plants worldwide and causing a sharp decrease in productivity [4]. As in most regions of the republic, in the Western region, it has a sharp effect, as a result of which the productivity of the wheat plant, as well as in a number of plants, drops sharply. Being the most abundant inorganic compound on Earth, water is a key mineral and is of great strategic importance, and currently its scarcity due to drought is becoming a global problem, resulting in reduced productivity in more than 70% of arable land. Loss of water mainly affects the relationship between hydrophobic and hydrophilic amino acids in proteins with water [5] and causes the denaturation of proteins that regulate metabolism in the organism and play an important role in biochemical reactions. One of the problems caused by drought stress caused by water loss is DNA and RNA degradation of nucleic acids, which play an important role in the chemical composition of the cell and are of biological importance. According to B. Kessler's data, the RNA-ase activity increases in the leaves affected by drought stress, which occurs as a result of the transition from the state associated with the enzyme to the free state (https://www.fao.org/news/archive/news-by-date/2010/en/). When there is a lack of water, the stomata are closed to prevent more water loss in the plant, at this time there is a restriction on the carbon dioxide intake necessary for the normal photosynthesis process, which results in an increase in the excitation energy in the reaction center of the photosynthetic apparatus [6].

Materials and methods

57 wheat varieties with different biological characteristics were used as research objects in the research work, 32 of these varieties are local, the materials of the "Cereals and Legumes" Department of the Institute of Genetic Resources of ANAS, and 25 are autumn soft wheat varieties obtained from CIMMYT (International Center for Maize and Wheat Improvement) (Table).

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Table

SOFT WHEAT VARIETIES USED IN THE STUDY

№	*Variety*	*Origin*	*№*	*Variety*	*Origin*
1	Gobustan	AZE	30	Yegane	AZE
2	Bol wheat	AZE	31	Tale 38	AZB
3	Arzu	AZE	32	Murov 2	AZB
4	Birlik	AZE	33	Gırmızı gul 1	AZB
5	Gurgane	AZE	34	Gobustan	AZB
6	Kharabag	AZE	35	Starshina	RUS-KR
7	Bezostaya 1	AZE	36	CO970547-7	USA-CO
8	Anza marker	AZE	37	Zubkov	KYR
9	Zardabi	AZE	38	MV 06-02	HU-MV
10	Parzivan 1	AZE	39	Gerek	TR-ESK
11	Parzivan 2	AZE	40	Gloriya	RO-FL
12	Grekum 75/50	AZE	41	TX96V2847	US-TX
13	Durdane	AZE	42	Arlin/Yuma	USA-KSU
14	Mirbashir 128	AZE	43	MV Dalma	HU-MV
15	Taraggi	AZE	44	Destin	RO-FL
16	Azeri	AZE	45	Dyuopebusa	MOL
17	Akinchi 84	AZE	46	OK00421	USA-OK
18	Giymetli 2/17	AZE	47	Altay	TR-ESK
19	Zirve 85	AZE	48	Mima	BG
20	Nurlu 99	AZE	49	LC927/Petja	BG-SAD
21	Azametli 95	AZE	50	Sonmez	TR-ESK
22	Sheki 1	AZE	51	Steklovidnaya 24	KAZ
23	Ruzi 84	AZE	52	Dalnitskaya	UKR
24	Guneshli	AZE	53	Vita	RUS-KR
25	Shafaq	AZE	54	Azeri	AZE
26	Seba	AZE	55	SG-S1915	CZ
27	Shafaq 2	AZE	56	Karahan	TR-KON
28	Ugur	AZE	57	U1254-7-9-2-1/TX86A5616//Rina-6	TCI

In order to determine the resistance to drought stress of the wheat genotypes under field conditions, measurements were made using the Turgoromer 1 device during the hot hours of the day (between 12:00-14:00) in the 8th layer leaves of the plants during spike, grain formation and milk maturity phases. For this, the thickness of the leaf was measured in 3 parts, and the plant was removed from the soil and kept in the field for 2 hours, and the thickness was recorded again by measuring it (μ). During the first measurement, the turgoromer indicator was marked with T1, and during the second measurement, the turgoromer indicator was marked with T2, and the water retention capacity of the leaf was determined by calculating the T2/T1 ratio. This method is also used in various physiological studies to determine the resistance of the wheat plant to drought [3]. This method is based on the reduction of leaf thickness due to the amount of water lost by the plant over a certain period of time.

Results and their discussion

The drought resistance of the local and introduced soft wheat genotypes we studied was determined in the stages of spike, grain formation and milk ripeness in all the cultivars in VIII-layer leaves, and according to their drought resistance, they were classified as I — drought resistant, II —

moderately drought resistant and III — sensitive to drought. As a result of the research, it was found that there is a positive relationship between the change in the thickness of the leaves and the water loss in the leaves. The biggest changes in leaf thickness due to drought were observed in spike, grain formation and milk ripeness phases.

The first group includes Gobustan (st.), Bol bugda, Grekum 75/50, Taraggi, Akinchi 84, Giymetli 2/17, Sheki 1, Tale 38, TX96V2847, Arlin/Yuma, MV Dalma, Desin, Dyuopebusa, SG-S1915 and U1254 -7-9-2-1/ TX86A5616// Rina-6 genotypes were included. The leaf thickness (T2/T1 ratio) in these drought resistant genotypes changed in the range of 0.82-0.88 mk in the control variant and 0.83-0.89 mk in the drought variant. According to variants, the genotypes with greater leaf thickness were Tale 38 (0.86 and 0.87 mk), Arlin/Yuma (0.86 and 0.88 mk), MV Dalma (0.87 and 0.88 mk) and SG-S1915 (0.88 and 0.89 mk). The difference between the leaf thickness (T1-T2) in these genotypes was 11.9-14.1% in the control variant, and 11.0-13.1% in the drought variant. It was determined that there was a decrease of 1.60-5.30% in the first measurement and 0.62-3.05% in the second measurement among the options due to stress. In the phase of grain formation, the genotypes with the largest leaf thickness were Arlin/Yuma, MV Dalma, SG-S1915 and U1254-7-9-2-1/ TX86A5616// Rina-6, each with 0.85 and 0.86 mk.

The third group included Bezostaya 1, Birlik, Gurgane 1, Karabakh 10, Parzivan 1, Parzivan 2, Azeri, Saba, Zubkov and Steklovidnaya 24 genotypes. In these drought-sensitive genotypes, leaf thickness (T2/T1 ratio) changed in the range of 0.63-0.74 mk in the control variant and 0.65-0.75 mk in the drought variant. According to variants, the genotypes with lower leaf thickness were Saba (0.63 and 0.65 mk), Karabakh 10 (0.64 and 0.65 mk), Zubkov (0.65 and 0.67 mk) and Parzivan 1 (0.65 and 0.68 mk), and the difference between the leaf thickness in these genotypes (T1-T2) was 34.8-37.0% in the control variant, and 31.6-34.8% in the drought variant. In the phase of grain formation, the genotypes with lower leaf thickness were the aforementioned Saba (0.61 and 0.63 mk), Karabakh 10 (0.63 and 0.64 mk), Parzivan 1 (0.63 and 0.65 mk) and Zubkov (0.63 and 0.66 mk).

In other studied 36 genotypes, this indicator was in an intermediate position and these samples showed moderate resistance to drought. In drought-resistant, medium-resistant and sensitive genotypes, this ratio was also reflected in the milk maturity phase.

In general, drought has a significant effect on the development of plants, preventing their growth, causing the breakdown of chlorophyll, the accumulation of hydrogen peroxide, which causes damage to the cell membrane, the increase of ascorbic acid and proline, the closing of stomata, the weakening of the transpiration rate, the reduction of the intensity of photosynthesis, and the decrease of the water potential in plant tissues [9].

It should be noted that in all genotypes water retention capacity decreased towards the end of vegetation. This reduction was higher in the control variant than in the drought variant. Thus, in the genotypes included in group I and showing resistance to drought, this decrease changed in the range of 2.33-7.00% in the control variant, 2.32-5.82% in the drought variant, and 4.69-9.46% in the drought-sensitive genotypes in the control variant, and 3.10-6.64% in the drought variant. The reduction of water storage capacity depends on the influence of external factors as well as on the biological characteristics of genotypes. Towards the end of the vegetation, the increase in temperature, the reduction of hydrophilic substances as a result of the transport of assimilates to the spike, and other factors led to a decrease in the water storage capacity.

Changes in leaf thickness under the influence of the external environment reflect changes in water content, synthesis and transport of organic compounds, growth and development of tissues. Based on this, there is a positive correlation between the change in the thickness of the leaves and the water loss in the leaves. It has been determined that the change in the thickness of the leaves before and after drying can be used as a reliable indicator for the assessment of drought resistance in wheat plants.

Based on the results of the research, the genotypes were ranked according to the level of drought resistance, and the relationship between their drought resistance and productivity indicators in the field conditions was determined. These genotypes are of special scientific interest as initial material in wheat breeding.

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