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INITIAL MATERIALS FOR IMPROVING DROUGHT AND HEAT TOLERANCE OF WINTER WHEAT VARIETIES AND SAMPLES

O'rinova G.E.[1], Murodova D.O.[2], Durmonova L.F.[3]
Karshi State Technical University

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Abstract

The article presents information on the drought and heat tolerance of winter wheat varieties and samples grown under irrigated conditions, as well as other factors. In this regard, it is stated that the methods for assessing drought and heat tolerance of winter wheat can be determined at different stages of the growing period and during the first phase of plant development.

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Introduction

One of the main climatic characteristics of wheat-growing regions in Uzbekistan is arid and hot conditions. Frequent droughts occurring in Uzbekistan have a significant impact on wheat plants throughout the growing season, causing a decrease in yield and grain quality. Therefore, one of the main requirements for newly developed varieties in Uzbekistan is the possession of drought and heat tolerance along with high productivity. Considering the above, it is advisable to study and select drought-tolerant varieties [1].

Literature Review

The study of drought and heat tolerance in wheat is one of the important scientific directions in global and local breeding practices. As a result of global climate change, the increasing frequency of drought and high temperatures negatively affects wheat productivity. Therefore, the development of varieties resistant to stress factors and the identification of effective initial materials for breeding programs are considered urgent tasks.[2]

In studies conducted by Chiniqulov B., drought tolerance indicators of certain soft wheat collection samples were investigated. The author emphasized the effectiveness of laboratory methods in identifying drought-tolerant genotypes. According to the research results, seed germination in osmotically active solutions and the degree of root system development make it possible to predict the level of resistance during subsequent stages of plant development [3].

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Issues related to the comprehensive assessment of drought and heat tolerance were thoroughly studied by R.A. Borodina. In her methodological recommendations, the necessity of using physiological and biochemical indicators in the evaluation of winter wheat varieties was highlighted. In particular, it was substantiated that the adaptation level of cells to water deficiency can be determined by germinating seeds in a sucrose solution. According to the author, annual adjustments in solution concentration should be made because the biological characteristics of seeds are influenced by the agro-climatic conditions of each year [4].

Research conducted by Umirov N.J., Xayitboev A.X., and Nurbekov A.I. identified valuable initial materials for breeding from world collections of soft wheat. The authors studied the biological and economically useful traits of genotypes originating from different geographical regions and noted the importance of genetic diversity in creating drought-resistant varieties. As a result of their research, several highly adaptable samples were recommended for breeding programs [5].

M.A. Amanov extensively studied the resistance of wheat to unfavorable environmental factors under the conditions of Uzbekistan. His research analyzed the response of wheat varieties grown in different soil and climatic conditions of the republic to drought and heat stress. The author emphasized that drought tolerance is a complex physiological trait closely associated with a well-developed root system, the ability to conserve water, and the stability of photosynthetic processes. It was also noted that crossing local and introduced samples is effective in developing heat-tolerant genotypes [6].

The physiological mechanisms of drought tolerance have also been widely studied by foreign researchers. According to J. Lelley, drought tolerance in wheat manifests differently at various stages of the vegetation period. Moisture deficiency during the stem elongation and heading stages has the greatest negative impact on yield. Therefore, a comprehensive study of plant responses to stress factors throughout ontogenesis is necessary when evaluating wheat varieties.[7]

The analysis of the above scientific sources indicates that laboratory methods, especially seed germination in osmotically active solutions, are effective and reliable for assessing drought and heat tolerance in winter wheat. Furthermore, studying world collection samples makes it possible to identify valuable genetic resources for breeding programs. This study was also carried out based on these scientific approaches and aimed at identifying promising initial materials for creating new drought- and heat-tolerant wheat varieties.[8]

Methodology

The experiment was conducted on 100 varieties and variety samples belonging to different ecotypes. In order to develop drought-tolerant varieties, the drought tolerance of soft wheat varieties and samples was studied under laboratory conditions based on seed germination in a sucrose solution, as well as the number and length of roots [9]. One of the earliest methods for determining drought tolerance in plants was proposed by A. Bullinger in 1927 and involved growing seeds in a sucrose solution. In our experiment, the level of drought tolerance was determined according to the method of N. Kojushko in the Plant Physiology Laboratory of the Kashkadarya Branch of the Research Institute of Grain and Leguminous Crops.[10]

Analysis and Results

According to J. Lelley, drought tolerance is not expressed equally throughout the entire growth period of wheat plants. Drought rapidly affects large areas and sharply reduces crop productivity. As a result, agricultural crops suffer significant damage. One of the most important measures against drought is the development of drought-tolerant crop varieties [11].

In this study, world collection samples and initial breeding materials were evaluated under laboratory conditions for drought and heat tolerance in order to develop drought-resistant and heat-tolerant wheat

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varieties suitable for the conditions of Uzbekistan. Today, methods for assessing drought and heat tolerance can be applied at different stages of the growing season and during the first phase of plant development.

According to R.A. Borodina, adjustments should be made annually to the concentration of the solution used for seed germination because seeds produced in different years have varying germination capacities. O.I. Gamzikov and L.G. Gudinova, who studied the drought tolerance of spring soft wheat under the conditions of Western Siberia, reached similar conclusions [12].

In the experiment, the germination rate of the standard variety "Yaksart," based on the number of emerged seedlings, was 92% in the control treatment and 97% in the sucrose solution. The number of roots was 3.9 in the control treatment and 3.0 in the sucrose solution (Table 1).[13]

Table 1. Evaluation of drought-tolerant soft wheat varieties and samples under laboratory conditions[14]

No.	Code	Variety and Sample Name	Germination, %	Number of Roots (Control)	Number of Roots (Sucrose)	Root Length, cm (Control)	Root Length, cm (Sucrose)	Coleoptile Length, cm (Control)	Coleoptile Length, cm (Sucrose)
1	1	H Beshir	97	3.9	3.0	9.2	3.7	3.9	2.3
2	11	Yaksart	97	4.0	3.0	9.2	1.6	3.5	1.6
3	3	BONITO-36/BILINMIYEN96.55 D-19	99	3.7	3.9	4.6	4.2	3.3	3.2
4	7	LUTESCENS-42*2//PBW343*2*/KUKUNA D-59	99	4.8	4.6	6.1	4.8	5.2	4.3
5	16	LUTESCENS-42*2/4/SERI.1B*2/3/KAUZ*2/BOW//KAUZ D-50	96	4.3	4.1	7.1	6.7	4.5	4.2
6	9	SKIPHYANKA*2//PRL/2*PASTOR D-79	99	3.5	4.2	7.3	6.1	5.0	4.5
7	21	AGRI/NAC//ATTILA/3/PYN/2*BAU	96	3.4	3.0	8.6	4.7	4.8	3.7
8	22	OGALLALA/KS95WGRC33//JAGGER/3/BETTY	98	5.0	4.3	6.4	5.8	4.9	4.6
9	41	AGRI/NAC//ATTILA/3/DORADE-6	98	4.6	4.3	5.4	4.1	4.9	4.6
10	42	8229/OK81306//SHARK-4/3/BONITO-37	97	4.1	4.4	4.1	6.3	3.8	4.9
11	43	ID800994W/VEE//F900K/3/PONY/OPATA/4/BUCUR D-23	96	4.5	4.8	6.7	7.9	5.8	5.3
12	44	SAD1//KATE/MVM/3/GENE/4/PEHL//VORN/BAU	99	4.2	3.6	5.1	4.6	4.8	4.0
13	64	ANAST/3/LUFER-1/MV OPT//F6038W12.1 D-35	99	4.8	4.0	5.5	4.9	4.8	3.8
14	65	KARLYGASH*2/TUKURU D-45	97	4.3	3.4	4.4	4.0	3.9	3.2
15	69	STEKLOVIDRAYA-24/4/SERI.1B*2/3/KAUZ*2/BOW//KAUZ D-85	99	3.7	3.9	4.8	5.3	4.8	4.3
16	70	SKIPHYANKA/4/SERI.1B*2/3/KAUZ*2/BOW//KAUZ D-95	98	3.3	3.0	5.4	4.7	3.4	3.2
17	58	SKIPHYANKA*2/4/SERI.1B*2/3/KAUZ*2/BOW//KAUZ D-74	99	3.8	3.2	6.5	5.9	4.7	4.3
18	95	ALMALY*2//PRL/2*PASTOR	96	3.9	3.3	3.6	3.2	2.5	2.9
19	96	LUTESCENS-42*2/TUKURU	100	3.6	3.1	3.8	3.4	3.4	3.2
20	99	ALMALY//PRL/2*PASTOR D-88	99	3.3	2.9	3.6	3.2	3.5	2.7
21	100	KUPAVA//PBW343*2/KHVAKI	99	4.1	3.9	5.0	4.8	3.4	3.0

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In the studied samples, seedling emergence ranged from 92–100% in the control treatment and from 97–100% in the sucrose solution. Compared with the standard variety, the selected variety samples had 3.3–5.0 roots in water and 2.9–4.8 roots in the sucrose solution. Nineteen varieties and samples that showed higher drought tolerance than the standard "Yaksart" variety had germination rates of 98–100% in the control treatment and 96–100% in the sucrose solution [15].

Conclusion

According to the results of the experiment, the soft wheat samples (OGALLALA/KS95WGRC33//JAGGER/3/BETTY, LUTESCENS422//PBW3432/KUKUNA D-59, ID800994W/VEE//F900K/3/PONY/OPATA/4/BUCUR D-23) demonstrated higher values in the sucrose solution for the number of emerged seedlings, number of roots, root length, and coleoptile length compared with the standard varieties and samples. Therefore, they were selected for future breeding programs and hybridization aimed at developing drought-tolerant soft wheat varieties.

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