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SPRING BARLEY (*HORDEUM VULGARE* L.) ASSESSMENT FOR DROUGHT RESISTANCE UNDER LABORATORY AND FIELD CONDITIONS

E.YU. PODLASOVA*, O.S. GRERCHISHKINA, S.V. LEBEDEV, and A.A. NOVIKOVA

Federal Research Centre of Biological Systems and Agrotechnologies, Russian Academy of Sciences, Orenburg, Russia
*Corresponding author's email: katerina.pryakhina@mail.ru
Email addresses of co-authors: fncbc2022@mail.ru, tony-novikova@yandex.ru, lsv74@list.ru

SUMMARY

Spring barley (*Hordeum vulgare* L.) cultivation mainly is for food, technical, and fodder crop. Drought is the major limiting factor in gross grain harvest, and the development of drought-resistant cultivars is the primary solution. The presented research aimed to assess the barley genotypes for abiotic stress caused by lack of moisture under laboratory and field conditions. The 100 genotypes of spring barley, belonging to various ecological groups, incurred evaluation under both conditions. In the laboratory setup, the drought resistance assessment of barley seedlings was in an osmotic solution of polyethylene glycol 6000 (PEG-6000). Six drought resistance indices related to germination and growth rates received calculations. In the field experiment, probing drought resistance ensued through the obtained grain yield. It is necessary to add indicators for measuring the drought resistance indices of seedlings and correlation (%). The barley genotypes with various parameters showed significantly ($P \leq 0.05$) varied response under the influence of moisture stress conditions. The Eastern European barley group with osmotic solution had a significantly higher root length than the control treatment. The correlation analysis proceeded between the drought resistance of barley seedlings in situ and their yield reduction intensity under field conditions. The positive and direct relationship was notable between the drought resistance indices and yield reduction in barley genotypes. The results showed the correspondence between the diagnosis of drought resistance of spring barley cultivars under laboratory and field conditions.

Keywords: Spring barley (*H. vulgare* L.), abiotic stress, drought resistance, polyethylene glycol 6000, drought resistance indices, grain yield

Key findings: The study comprised evaluation of spring barley (*H. vulgare* L.) genotypes for drought resistance under field and laboratory conditions. A positive correlation emerged between the crop drought tolerance index and root mass drought tolerance index.

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INTRODUCTION

Rapid warming trends were evident through monitoring of climate change in Russia. However, in the Northern regions, it also improves heat supply required by the crops, enhancing the length of the growing season, resulting in an increased productivity. Warm climate also leads to an elevated likelihood of drought in the Southern and Central zones of the country (Novikova, 2012; Kapoor *et al*., 2020). Under such environmental conditions, the issues of drought resistance in some crop cultivars become extremely critical (Oguz *et al*., 2022).

Barley (*Hordeum vulgare* L.) is the world's fourth-largest cereal grain crop, widely used as animal feed, human food, and in providing raw material for brewing. Its yield potential even exceeds the spring wheat under the same environmental conditions, likewise, playing an important role in obtaining highly productive grains. However, drought stress can reduce its yield by 50%–85% (Hafez *et al*., 2020; Elakhdar *et al*., 2022). Breeding drought-tolerant barley cultivars is the most cost-effective approach in minimizing drought's negative impact on productivity (Mwando *et al*., 2020).

Barley is a tough cereal, grown in various environments where other grains are unable to grow—from arctic latitudes and alpine altitudes to saline desert oases. The genotypes' selection success largely depends upon the thorough and correct assessment and choice of parental genotypes (Macholdt and Honermeier, 2017; Vaezi *et al*., 2019). Therefore, to address the abiotic stress problem, using all germplasm with the highest resistance is necessary for hybridization (da Silva *et al*., 2020; de-Silva *et al.*, 2021).

Numerous methods are helpful for assessing the drought resistance of crop genotypes, and the assessment through field and laboratory conditions is one of them. The most convenient and rapid method for determining the drought tolerance of crop genotypes is to evaluate the relative drought tolerance in vitro using osmotic solutions, such as, polyethylene glycol 6000, sucrose, and mannitol (El-Badri *et al*., 2021; Chen *et al*., 2022). It determines the stress resistance of crop plants at the germination stage. This method also allows for year-round evaluation and screening of large number of lines and hybrids, and considerably boosts the breeding process (Xue *et al*., 2020).

However, authenticating the reliability of laboratory results can be by direct assessment of the said genotypes for drought resistance under field conditions. In such setup, appraising the impact of soil and air drought on various cultivars is via productivity and comparing the grain yield of the cultivars under drought stress and non-stress conditions during different years of study. As drought does not occur every year, its duration and timing of onset varies, and such studies also require long-term observations (Albertos *et al.,* 2021; Rajora *et al*., 2022).

In the present era, a dire need to determine the relationship between assessing the relative resistance to stress during seed germination under laboratory conditions and genotypes evaluation for drought resistance under field conditions exists. The presented research also aimed at a comparative assessment of the responses of barley genotypes to abiotic stress caused by lack of moisture under laboratory and field conditions.

MATERIALS AND METHODS

Plant material

The object of the study comprised 100 spring barley (*H. vulgare* L.) genotypes, including 14 cultivars and 28 lines (selected by the Federal Research Centre for Biological Systems and Agricultural Technologies) and 58 cultivars (selected from the collection of All-Russian Institute of Plant Genetic Resources named after N.I. Vavilov – VIR, Russia) (Table 1). For convenience in description, dividing the barley genotypes into groups depended on their regions of origin.

Field studies

The field work commenced during 2021–2022 in the experimental fields of the Federal

Table 1. Description of cultivars and lines of spring barley used in the study.

Cultivars	Origin	Cultivars	Origin
The South Ural Group			
Orenburg 11	Russia	D-1333	Russia
Orenburg 15	Russia	D-1334	Russia
Orenburg 17	Russia	D-1335	Russia
Anna	Russia	D-1336	Russia
T 12	Russia	D-1337	Russia
Primary clinic	Russia	D-1338	Russia
Miar	Russia	D-1339	Russia
Natalie	Russia	D-1340	Russia
Armilide	Russia	D-1341	Russia
Lida	Russia	D-1346	Russia
Chebenek	Russia	D-1347	Russia
Gubernatorial	Russia	D-1349	Russia
The Healer	Russia	D-1350	Russia
Orenburg Joint	Russia	D-1351	Russia
D-1324	Russia	D-1352	Russia
D-1325	Russia	D-1353	Russia
D-1326	Russia	D-1354	Russia
D-1327	Russia	D-1355	Russia
D-1328	Russia	D-1357	Russia
D-1331	Russia	D-1358	Russia
D-1332	Russia	D-1378	Russia
The Steppe Group			
Donetsk 12	Ukraine	Hawk	Russia
Ricotense 2006	Kazakhstan	Medicum 108	Russia
Tulpar	Kazakhstan	Karaganda	Russia
Donetsk 8	Ukraine	Medicum	Russia
Nutans 401	Russia	Arna	Kazakhstan
Kamyshinsky 23	Russia	Turan -2	Kazakhstan
Berkut	Russia	Dmitrievsky 5	Russia
Zernogradsky 770	Russia	Leon	Russia
Priazovsky	Russia	Akzhal	Kazakhstan
Generous	Russia		
The Siberian Group			
A gift from Siberia	Russia	Siberian Avant-garde	Russia
Bagan	Russia	In memory of Chepelev	Russia
Binomial	Russia	Vladuk	Russia
Sasha	Russia		
The Eastern European Group			
Mriya	Ukraine	The Warrior	Russia
Mironovsky 92	Ukraine	HZ-250	Russia
Cherkassky 240	Russia	Zeus	Russia
The Symphony	Russia	Velez	Russia
Moscow 3/84	Russia		
The Western European Group			
Skarlet	Germany	KM-143	Czech
Halla	Germany	Alsa	Lithuania
KM-341	Czech	Idumeja	Latvia
Piramid	France	Canada	Canada
Ditta	Czech	City	France
Fleet	Netherlands	Primus	Czech
Olbram	Czech	Eifol	France
Prestige	Czech	Etronne	Canada
Alondra	Germany	Klondike	Canada
896/80	Czech	Tankard	Canada
Coyo	Mexico	Haxby	USA
		Craig	Canada

Research Centre BST RAS, Chebenki Village, Orenburg Region, Russia. The precursors of barley in the field experience bore describing, providing the characteristics of the crop rotation/monoculture, as the background of the field part of the experiment. The soil of the experimental site was ordinary chernozem, medium-dense, medium- and low-humus (4.69% to 7.60%) (GOST, 26213-91). The nitrogen supply was low (GOST, R 58596-2019), phosphorus was average (GOST, 26205), and potassium was high (GOST. 26205). The soil characteristics of the study site should be according to the WRB classification. The content of nutrients in the soil and its properties (for example, pH, SOM, clay content, and others) require presentation in absolute values, and not in relative values according to the scales adopted in Russia. The predecessor was complete fallow. The registration plot was 16.4 m^2, repeated three times. The study of barley cultivars was against a natural infectious background. For conducting the experiments, the agrotechnical conditions corresponded to the agricultural technology adopted in the central zone of the Orenburg Region, Russia. When describing weather conditions, the provided data for the growing season need comparing with the average annual norm. The work must have supplemental information on agrotechnical methods of cultivation.

The Orenburg Region climate was extreme continental (Table 2). According to AMP Chebenki of the Orenburg Region, the year 2021 can have the characteristic of an acutely dry year. The hydrothermal coefficient (HTC) was 0.15–0.20 units. During the growing season, the atmospheric precipitation was extremely uneven. The atmospheric precipitation during the development period was 31.7 mm, which was below the norm in May (30.9 mm), June (30.1 mm), and July (31.0 mm). The sum of active air temperatures was 1576.1 °C, the average daily temperature was 4.4 above normal, and 3.1 °C and 1.6 °C in May, June, and July, respectively. The number of days with a minimum relative humidity (30% or less) was in the range of 57 to 66 (Figure 1). According to the weather conditions description, the provided data for the growing season requires comparison with the average annual data for the same period. In addition, the observed conditions during the growing seasons of 2021 and 2022 were either dry or not.

According to meteorological observations, the year 2022 can be distinctly wet, and the HTC was equal to 1.64 units. The sum of active air temperatures during the growing season of spring barley ranged from 1364.6 °C to 1448.8 °C. Analysis of variations in average daily air temperature showed sharp fluctuations in air temperature in May, June, July, and August 2022. In May and June, the temperature was below the normal climate. However, the high temperature was notable in the second to third week of July and August. During the study period, extremely uneven precipitation was prevalent. The precipitation amounted to 249.1 mm, while in May and July, it exceeded the average long-term norm (343.2% and 210.9%, respectively). In June and August, it was below the norm (49.1% and 1.9% of the norm, respectively). Meanwhile, in the 20 days of July and in the third and fourth week of August, no precipitation occurred.

Laboratory studies

The analysis of the relative drought resistance in spring barley also transpired in 2023. The use of 20% PEG 6000 developed osmotic stress, while using distilled water in the control version. Why did the authors use 20% PEG 6000 to develop osmotic stress? Before germination, the disinfection of barley genotype seeds continued in a 2% chlorine solution for five minutes. Afterward, washing the seeds with distilled water completely removed the disinfectant solution. The experiment, carried out in Petri dishes, was in triplicate. The barley seeds' germination ensued in a climate chamber in the dark at a temperature of 200 °C (GOST 12038-84). This was probably a mistake— germinating barley in a climate chamber in the dark at a temperature of 200 °C (GOST 12038-84). On

Table 2. Air temperature and humidity during the growing seasons of spring barley for 2021–2022.

Meteorological indicators	10/20/30 days					
	I		II		III	
	2021	2022	2021	2022	2021	2022
May						
Maximum air temperature (°C)	28.0	22	36.0	18	38.0	27
Minimum air temperature (°C)	2.0	-5.0	8.0	0	8.0	2.0
Average daily air temperature (°C)	12.3	9.5	21.0	10.7	22.9	14.2
Deviations from the average climatic norm (°C)	1.6	-2.1	5.6	-2.7	6.2	-1.2
Average relative humidity (%)	42	43	35	74	34	65
Average relative humidity deficit (hPa)	14	8	22	4	24	7
June						
Maximum air temperature (°C)	32.0	27.0	37.0	30	42.0	35.0
Minimum air temperature (°C)	6.0	4.0	9.0	5.0	13.0	2.0
Average daily air temperature (°C)	20.3	15.5	23.4	18.2	27.2	19.0
Deviations from the average climatic norm (°C)	1.4	-1.4	2.6	-0.7	5.5	-1.0
Average relative humidity (%)	45	64	32	58	33	55
Average relative humidity deficit (hPa)	16	8	25	11	26	12
July						
Maximum air temperature (°C)	38.0	30.0	37.0	37.0	39.0	33.0
Minimum air temperature (°C)	13.0	5.0	9.0	12.0	6.0	8.0
Average daily air temperature (°C)	25.4	18.2	22.8	24.9	22.8	20.8
Deviations from the average climatic norm (°C)	3.2	-1.8	1.1	4.7	0.5	0.5
Average relative humidity (%)	38	55	42	44	44	54
Average relative humidity deficit (hPa)	20	11	21	22	19	14
August						
Maximum air temperature (°C)	42.0	30.0	40.0	31.0	49.0	33.0
Minimum air temperature (°C)	9.0	10.0	8.0	6.0	9.0	10.0
Average daily air temperature (°C)	25.4	21.4	23.5	19.2	24.2	22.6
Deviations from the average climatic norm (°C)	3.6	1.4	3.5	0.0	5.6	4.2
Average relative humidity (%)	33	53	27	43	29	44
Average relative humidity deficit (hPa)	27	14	28	15	27	18

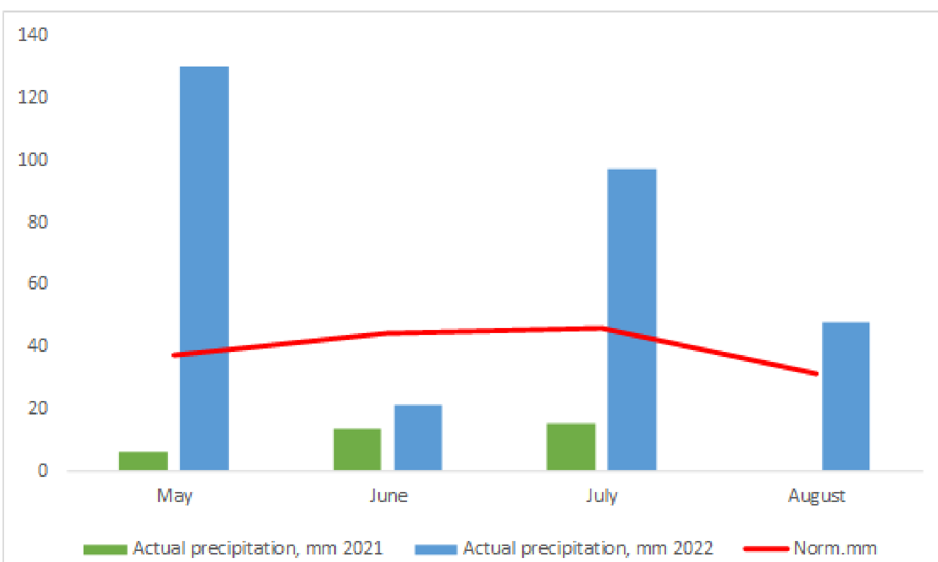

Figure 1. Dynamics of precipitation in the steppe zone of the Orenburg Urals in 2021 and 2022.

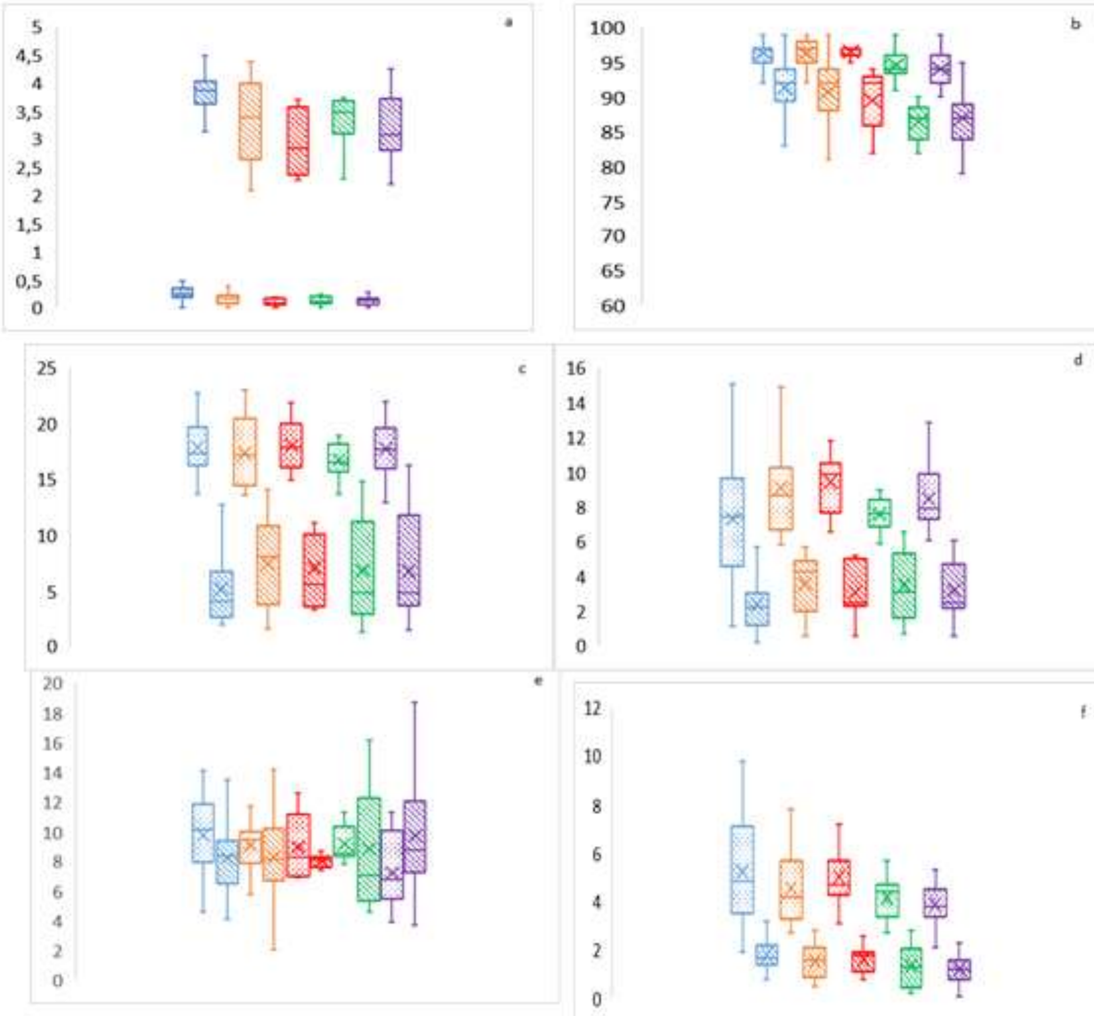

Figure 2. The average values of yield (a), t/ha and morphometric parameters of seedlings of various groups of barley - germination % (b), length of the seedling cm (c), weight of the seedling 10^{-3} mg (d), root length cm (e), and root weight 10^{-3} mg (f), depending on the moisture conditions. The color shading corresponds to the group:

Steppe Group, Siberian Group, South Ural Group, Eastern European Group,

Western European Group, favorable conditions, drought conditions.

the seventh day, determining the traits included germination percentage, shoot and root length, and shoot and root mass. Drought resistance indices, the direct field yield (DI), germination rate (G), seedling length (SL), root length (RL), seedling weight (SR), and root weight (FR) also sustained calculations (Lan, 1998).

Statistical analysis

Statistical processing of the data applied the method according to Dospekhov (2014). Sorting the general data employed the Microsoft Excel 2021. Correlation studies of the drought indices used the Statistica-12 software.

RESULTS

Drought stress significantly influenced grain yield of barley (*H. vulgare* L.) genotypes under field conditions, as well as, the morphological parameters of the seedlings in the laboratory, causing inhibition of growth processes in most cases (Figure 2). The average grain yield during the study years ranged from 0.20 t/ha (with NSD05 = 0.01) in 2021 to 3.45 t/ha (with NSR05 = 0.28) in 2022. When characterizing the yield indicator in 2021 and 2022, the use of different indicators (NSR and NSF) is supposedly to assess the reliability of data differences for a significance level of 0.05. However, in 2021, the maximum grain yield obtained was in the barley cultivar Lekar (0.48 t/ha), while the minimum and same grain yield resulted in the cultivars Eifol and Etronne (0.01 t/ha). In 2022, the grain yield was 4.50 and 0.28 t/ha in the barley genotypes D-1324 and Dmitrievsky-5, respectively. Average productivity by origin groups in 2021 ranged from 0.08 to 0.48 t/ha in barley samples of the Orenburg selection, 0.05 to 0.39 t/ha in the steppe group, 0.05 to 0.25 t/ha in the Eastern European group, 0.01 to 0.38 t/ha in the Western European group, and 0.05 to 0.2 t/ha for the Siberian barley group. However, in 2022 in these groups, the average grain yield exceeded the 2021 values by 92.9%, 94.9%, 95.9%, 95.8%, and 96.1%, respectively. Has the relationship between the studied barley yield and climatic conditions been noticeable in the field experiment?

The osmotic solution significantly affected the germination and morphometric characteristics of barley seedlings, causing inhibition of growth processes. The studied barley samples had a high initial germination rate (89%–96%). However, the germination on PEG-6000 led to a decrease in germination rate relative to the control samples of the South Ural group by 5%, the steppe group by 5%, the Siberian group by 6%, the Eastern European group by 8%, and the Western European group by 7%.

In the control variant, in all the barley groups, the average shoots length varied from 12.9 to 23 cm. However, the maximum shoot length appeared in the South Ural group and the minimum in the Eastern European and steppe groups. On average, in the osmotic solution, the germination rate significantly ($P \leq 0.05$) reduced the seedling length by 7.7 cm (42.3%). The cultivars of the Eastern European group suffered the most from the stress effects. A substantial ($P \leq 0.05$) decrease in their seedling length was 9.9 cm (62.3%) relative to the control, with 2.7 cm in the cultivar Mriya, 7.4 cm (Symphony), 4.8 cm (Moskovsky), 1.3 cm (Ratnik), 4.7 cm (Zeus), and 3.2 cm (Veles). In the barley steppe group, the said indicator revealed a notable ($P \leq 0.05$) reduction by 57%, in the Siberian group (60%), in the Western European group (61%), and in the South Ural group (20.8%).

By studying the root length, the higher varietal response to stress was an outcome. A significant ($P \leq 0.05$) increase emerged in root length by 15.4% in the Eastern European group of barley. This was visible in the barley cultivars Mironovsky-92 and GC-250, where the root length enhanced by 3.0 and 7.6 cm relative to the control. However, in barley cultivars and lines of the South Ural group, the average root length had a considerable ($P \leq 0.05$) decrease by 0.3% to 64%. In the steppe group, by 2.6% to 78.3%, in samples of the Siberian group, by 5.9% to 48%, and in the Western European barley group, by 9.5% to 79% versus the control. The longest root length was remarkable in the control and in the experimental variants with barley lines D-1335 (14.1 to 11.1 cm) and Karaganda (13.7 to 8.3 cm). Meanwhile, the least values for the said trait were distinct for the barley cultivar Dmitrievsky-5 (3.9 and 2 .1 cm).

Analysis of the variability of seedling and root mass per plant showed a general decrease in all the barley lines and cultivars. The barley samples from the Siberian group emerged the most sensitive to drought according to this trait. Significant ($P \leq 0.05$) differences arose with the control in the seedling and root weight (by 75.5% and 68.0%, respectively). The barley samples from the South Ural and steppe groups had the greatest resistance to stress. Deviations ($P \leq 0.05$) relative to the control were 43.5% and 46.2% for seedling weight, and 46.4% and 57.0% for root weight, respectively. The most intensive accumulation of biomass under stress conditions for shoot and root weights resulted in the barley cultivars Natali (5.7 and 0.2 mg), Orenburgsky Sovmestny (4.8 and 1.7 mg), and Lekar (2.3 and 0.5 mg).

The values of drought resistance indices, viz., the direct field yield (DI), germination rate (G), seedling length (SL), root length (RL), seedling weight (SR), and root weight (FR) appear in Figure 3. Calculation of the direct drought resistance index showed the highest DI occurred in barley cultivars of the South Ural group (Orenburgsky Sovmestny, Lekar, Armilid – 0.3), steppe group (Dmitrievsky and Berkut – 0.2), Siberian group (Vladuk – 0.1), Eastern European group (Mironovsky 92 and D-250 – 0.1), and Western European barley group (Scarlet – 0.1 and Piramid – 0.2).

The manifestation of FR stress was minimal in barley cultivars of the Eastern European, steppe, and South Ural groups, with values of 0.05, 0.06 and 0.01, respectively. The samples of the Siberian group (0.59–0.16) suffered the most based on this indicator. Regarding the barley samples, the most resistant cultivars resulted as D-1353 (1.6), D-1333 (1.5), Orenburgsky-17 (0.8), and Ricotense 240 (1.0). The SR indicators ranged from 0.01 to 0.9, and the highest value was notable in the cultivar Anna (0.9) and in cultivars Orenburgsky-11, Zernogradsky-770, Akzhal, Vladuk, Symphony, and Flect, with the said value as 0.8. The minimum value (0.01) occurred in the barley cultivars Craig, Etrinne, and Siberian Avangard cultivars. The index of drought resistance of seedlings G ranged from 0.73 to 1.1, while the minimum value (0.73) was evident for the varieties Craig and Etrinne.

In the drought resistance indices, the seedling and root lengths were within the range of 0.01 to 1.9 and 0.05 to 3.9, respectively. It is important to note the maximum seedling length appeared in the cultivars D-1336 (1.9), Haby (1.8), Armilid, and Lida (1.6), and for root length, in cultivars Kamyshinsky-23 (2.6), Natali (3.0), Halla (2.6), and Eifol (2.2). Analyzing the correlation among drought resistance indices makes it possible to establish the degree of conjugation of the main indicators against the limiting factors, providing the opportunity to determine the diagnostic signs for assessing spring barley genotypes for drought resistance. Based on correlation analysis, it was noticeable that the direct drought resistance index (DI) of spring barley largely had associations with the FR and SL indices (R_2 = 0.2162 and R_2 = 0.2156). The significant correlation of the DI index was less pronounced with G (R_2 = 0.1031), RL (R_2 = 0.1180), and SR (R_2 = 0.1328). According to correlation analysis, not only the strength of the connection is essential, but also, its sign is positive or negative. The outcomes are not entirely clear. The research methods show the experimental part consists of laboratory and field experience. But, the results and discussion do not show the relationship between the results obtained at these stages of the experiment. Are the laboratory experience data supported by the results of field research?

DISCUSSION

Abiotic stress caused by drought poses a serious problem for barley production in grain-growing regions of Russia and around the world. The development of drought-resistant cultivars is the primary way to resolve the issue of barley grain production in the risky farming regions (Sabagh *et al*., 2019). Currently, most crop studies focused on the effects of drought during the germination period (Sallam *et al*., 2019; Dubois and Inze, 2020; Novikova *et al.,* 2022). Drought tolerance detection can come from identifying a trait beneficial to measure the effects of drought tolerance on crop plants. Traditionally, drought tolerance calculation results from yield loss under drought conditions; however, field tests are very time-consuming, labor-, and cost-intensive, and easily incurring environmental factors influences (Nikolaev *et al*., 2019). Understanding the relationship between the direct drought resistance and genotype resistance at the seedling stage is relevant, since laboratory assessment can help the crop breeders in reducing work time and increase the efficiency of selection.

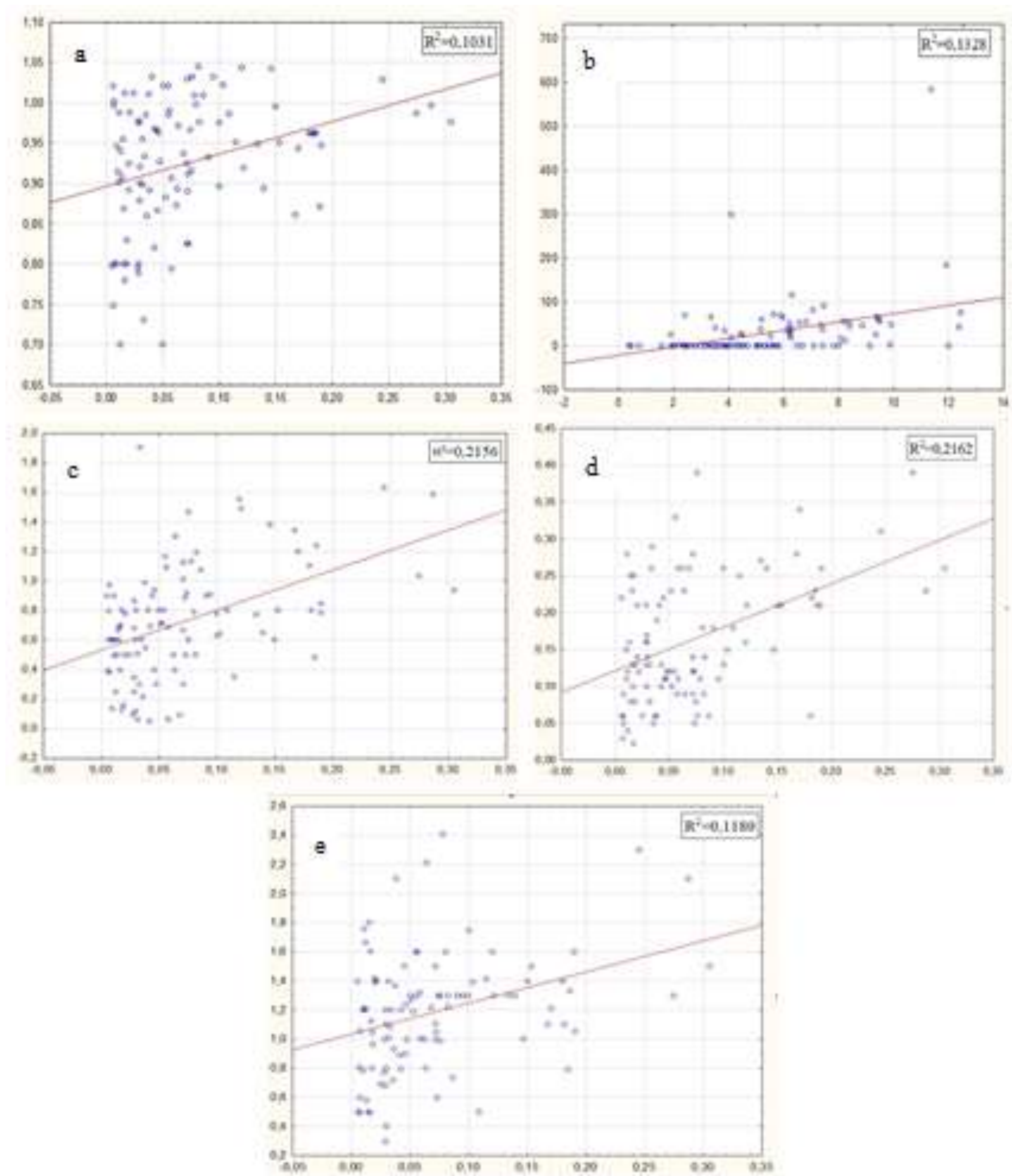

Figure 3. Correlation between (X-axis) direct drought resistance index DI and (Y-axis) relative drought resistance indices G (a), SR (b), SL (c), FR (d), and RL (e).

In the presented research, a comprehensive assessment of drought resistance continued on 100 genotypes of spring barley of various eco-geographical groups under field conditions based on grain yield and laboratory conditions. Likewise, it examined variations in germination and main morphometric indicators at the seedling stage. The analysis of variance revealed significant differences in grain yield of barley cultivars grown in 2021 and 2022. The barley cultivars Orenburgsky joint, Lekar, Dmitrievsky-5 had the smallest average decrease and showed better drought resistance. However, the maximum decrease was evident in cultivars Donetsky-12, Priazovsky, Podarok Sibiri, Symphony, Zeus, and Flect, as such, recognized as the more sensitive to drought. What varieties are recommendable for growing in the region, considering the data obtained?

Assessment of drought resistance in cultivars based on productivity seemed the most accurate in many studies (Lopes *et al*., 2012; De-Silva *et al*., 2021; Elakhdar *et al*., 2022). However, it is longer and more labor-intensive. Laboratory diagnostics of crop genotypes for drought tolerance using closely related traits including morphological traits, biomass, osmotic regulation, nutrient ratios, and oxidative properties is apparently more convenient and effective (Orosa-Puente *et al*., 2018; Ogura *et al*., 2019; Sabagh *et al*., 2019; Bapela *et al.,* 2022). Among these variables, the shoot and root length, shoot and root weight were specifically the main traits widely used to determine the drought tolerance in barley (Cai *et al*., 2019).

The promising studies showed barley genotypes with various parameters gave significantly ($P \leq 0.05$) varied response under the influence of moisture stress conditions. The Eastern European barley group with osmotic solution had notably higher root length than the control treatment. The average values of other traits during germination on PEG-6000 were lower than the control. In the variables, the degree of reduction was varied, depending on barley cultivars and indices. Have there been any differences in drought resistance between different eco-geographical groups of barley varieties? However, some spring barley cultivars were more resistant according to the traits, i.e., DI and FR (Orenburgsky-17, Ricotense-240), DI and SR (Orenburgsky-11 and Anna), DI and SL (Lida Haby), and DI and RL (Natalie Kamyshinsky-23). The remarkable positive correlation between DI and FR suggests high FR rates under the drought conditions have closer correlation to DI. However, it is desirable to describe more specifically the relationship between drought resistance in field and laboratory studies (Lodhi *et al*., 2015; Kushanova *et al*., 2023; Sabra *et al*., 2023). Likewise, the studies provided significant positive correlation of DI with SR, G, SL, and RL, and may be the potential drought indices for barley genotypes under drought stress conditions.

CONCLUSIONS

The results revealed the direct and relative drought resistance of spring barley (*H. vulgare* L.) cultivars and lines. The maximum drought resistance indices were prominent for the barley genotypes, i.e., Lekar (DI = 0.3), Miar (G = 1.0), D-1353 (SR = 1.5), D-1336 (SL = 1.9), Natalie (RL= 3.0), and Anna (FR= 0.9). The correlation analysis enunciated a significant relationship ($R2 = 0.2162$) between the drought resistance index of yield (DI) and the drought resistance index of root mass (FR). The study provides useful information for the development of drought-tolerant cultivars and a theoretical basis for justifying the significance of laboratory assessment of drought tolerance in spring barley.

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