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Morphological and yield responses of 20 genotypes of bread wheat to drought stress

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Abstract: The aim of this study was to select wheat genotypes most resistant to drought stress. The experiment was conducted at the research farms of the Faculty of Agriculture, Kurdistan University, Sanandaj, Iran, during 2014-2015 and 2015-2016. A randomized complete block design with three replicates using 20 genotypes of rain-fed wheat was applied. Cluster analysis of different wheat genotypes segregated the genotypes into 3 groups. Comparison between the groups in the first crop year revealed that the second and third groups exhibited the highest rate of radiation-use efficiency (RUE), and the first group had the lowest. Grain yield was highest in the third group and lowest in the first group, with an average of 219.87 g/m2 and 173.40 g/m2, respectively. In the second crop year, the highest rate of RUE was reported in the first group and lowest in the second and third groups. The highest grain yield was observed in the second group and the lowest in the third group (315.40 g/m2 and 253.75 g/m2, respectively). Based on the results of the biplot, high-yield genotypes in the first year of cultivation included G14 (263.00 g/m2), G20 (264.50 g/m2), G18 (214.00 g/m2) and G19 (222.50 g/m2). Based on the results obtained by cluster and PCA analysis under stress conditions, we concluded that several traits play a role in determining the grain yield of wheat.

Keywords: cluster analysis; principal component analysis; RUE; bread wheat; drought stress

INTRODUCTION

Drought is the most important limiting factor of wheat production across the world [1]. Drought stress in plants occurs when the transpiration rate from leaf surfaces is higher than water uptake by roots. Terminal drought that occurs during post-anthesis significantly reduces wheat grain yield due to induced grain abortion, and it affects grain filling, resulting in shriveled grain and a reduced grain yield [2]. Drought stress influences seed germination, seedling growth, dry matter partitioning and root growth, root depth and extension [3]. Grain yield in wheat mainly correlates with yield components and it has been reported that any reduction in a yield component leads to a reduction in the final yield. In Iran, the wheat grain filling period usually experiences drought stress [4]. Solar radiation is considered to be an environmental resource for stable and effective crop production. Indeed, there is a positive relationship between crop yield and light absorption. Hence, crop yield can increase with increasing light use efficiency [5].

To study the yield and yield components of wheat grain, quantifiable traits such as grain number and weight and/or physiological components such as biomass and harvest index (HI) can be measured. Wheat grain yield has a strong relationship with grain number [7]. In some regions, especially in recent decades, grain weight has had an important role in the increase of wheat grain yield [8]. Grain number is mainly determined by the number of surviving florets within spikelets in parenthesis [9]. Spikelet dry weight of wheat is expressed as a function of spikelet growth duration, crop growth rate and biomass partitioning to spikes; the increase in any one of these traits in parenthesis aids spikelet growth and production of live florets [10]. Farnia and Tork [11] reported that drought stress negatively affected the yield of grain components, such as the number of ears per m^2, 1000-kernel weight and biologic yield. The increase in grain yield among different wheat genotypes under drought stress conditions is due to increasing grain per ear; the effect of grain per ear on grain yield under drought stress is greater than

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other traits such as 1000-kernel weight [12]. Fischer [10] pointed to a strong relationship between grain per m^2 and total dry matter in wheat under drought stress condition. Accordingly, It was shown that the end of season drought reduced grain yield [12].

Improvement of wheat yield has traditionally relied on direct selection for agronomic traits. Therefore, wheat breeders are always looking for sources that will contribute to improved grain yield. It is increasingly important to identify stable and high-yield wheat genotypes, considering the increase in world population and its demand for food, especially in developing countries. Adding to the urgency of finding drought-resistant wheat is the water deficit in arid and semi-arid regions of world, and the long-term stress in these regions, including Iran. Therefore, this study was conducted to investigate the effect of some morphological and physiological traits on grain yield, with the aim of identifying the best genotype(s) in terms of grain yield and yield stability. To address this, 20 genotypes of bread wheat were studied under drought stress conditions in the province of Kurdistan.

MATERIALS AND METHODS

Study site and experimental design

The experiment was conducted at the research farms of the Faculty of Agriculture, Kurdistan University, Sanandaj, Iran (35°37' N, 47°22' E, 1494 m a.s.l.) during two consecutive growing seasons, 2014-2015 and 2015-2016, October-June. A randomized complete block design with three replicates was used, and 20 genotypes of rain-fed wheat (Supplementary Table S1) were tested and compared under stress conditions. The meteorological characteristics of the study region are given in Supplementary Table S2.

Field preparation and plot establishment

Each experimental plot consisted of six rows, 6 m in length and 20 cm apart. Seeds were sown at a density of 400 seeds/m^2 on November 20, 2014 and 2015. Fertilizer recommendations were based on the results of soil analysis from experimental farms in Kurdistan. The amount of fertilizer used before sowing was about 50 kg N (urea) and 50 kg P (ammonium phosphate)/ha, (with potassium (K) being plentiful in the soil in Iran).

Measuring light absorption percentage and radiation-use efficiency (RUE)

In order to determine the percentage of light received by wheat, the light above and under the canopy was measured with a tube photometer (model LICOR-LI-250A) at five stages for each treatment. For each growth stage, light absorption percentage was determined using the equation 1 [13]:

$$\%I_{abs} = (\frac{I_0 - I}{I_0}) \times 100$$

where I_{abs}=light absorption percentage, I_0=light above canopy, I=light under canopy.

Radiation-use efficiency (g/Mj) was obtained via the slope of the linear regression between total biomass (g/m^2) and total photosynthetically active radiation absorbed by the plants canopy during the growing season [14].

Leaf relative water content (RWC)

Leaf relative water content was measured at solar noon on ten flag leaves at two growth stages (late booting, early grain filing). Ten leaves were cut from each plot at 8.00 a.m., weighed immediately (to obtain the fresh weight or FW), floated in the dark for 24 h to achieve and measure turgidity (turgid weight or TW), then oven-dried at 105°C for 24 h and weighed again (to obtain the dry weight or DW).

The water saturation deficit (WSD) of leaves was calculated as follows:

$$WSD=[(TW-FW)/(TW-DW)]\times 100\%.$$

The relative water content (RWC) was calculated as follows:

$$RWC (\%)=(FW-DW)/(TW-DW)\times 100.$$

Agronomic traits

At the end of the growing season (250 days after planting on June 28), the final harvest was performed by harvesting the four middle rows once they reached physiological maturity. The plants within a 1-m^2 area were harvested from each plot. The roots and shoots were separated and washed with deionized distilled water. Root traits such as root length and root dry weight (RDW) were measured. The yield components such as ear per m^2 and grain per ear were calculated by counting the grains per ear. Grains were separated from the rest of the plant parts and grain yield and 1000-kernel weight were determined by weighing 1000 grains harvested in the 1-m^2 area from each plot. In order to determine the biologic yield, the wheat shoots were dried and the harvested plants of each plot (1 m^2) were weighed on a digital scale. The dried plants with grain yield represented the biologic yield. Harvest index was calculated according to the following formula:

Harvest index (%)=(Grain yield/Biologic yield)×100.

Statistical analysis

For all data, analysis of variance (ANOVA) was performed to test for differences between genotypes [15]. Differences among treatments were analyzed by a least significant difference (LSD) test at $p \leq 0.05$. Principal component analysis (PCA) was performed to visualize the similarities or differences in all traits under different drought stress (i.e. the first and second crop year), using SAS. The results of this analysis are presented as bi-plots. Clustering was performed in S-PLUS ver. 6.1 software (Insightful Corporation, USA) using Ward's hierarchical approach based on the minimum variance linking method with Euclidean distance as the similarity measure. Prior to cluster analysis, the seminal root data were standardized by subtracting the values for each genotype from the overall mean, then dividing by the standard deviation.

RESULTS

The results from the Bartlett test showed that for most of the studied traits there was a significant difference between the two crop years, hence the statistical analyses were performed on each crop year separately. Cluster analysis of the first year divided the 20 wheat genotypes into 3 groups as follows: 5, 11 and 4 genotypes in groups 1, 2 and 3, respectively (Fig. 1). In the second year, the genotypes formed three groups with 8, 11, and 1 genotype, respectively.

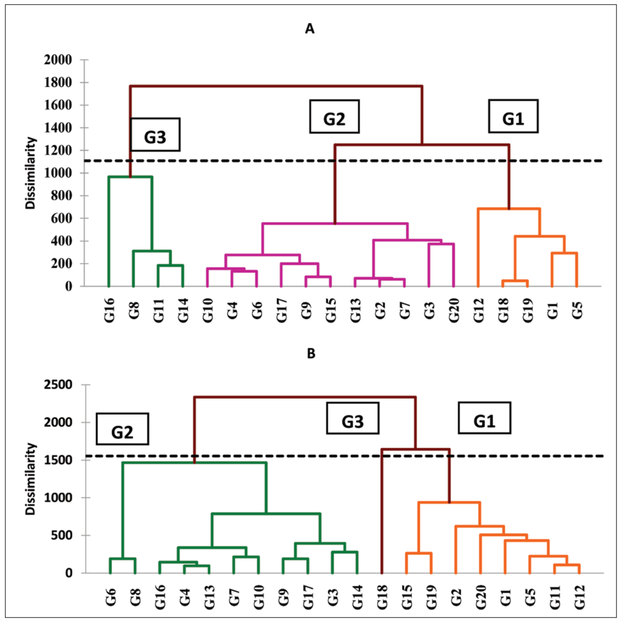

Fig. 1. Dendrograms derived from cluster analysis related to different crop years in wheat genotypes. **A** – first year; **B** – second year. G1: 3; G2: 12; G3: 18; G4: 9; G5: 15; G6: 17; G7: 11; G8: 25; G9: 30; G10: 36; G11: 45; G12: 48; G13: 2; G14: Azar-2; G15: Karim; G16: Cross sabalan; G17: Rizhab; G18: Avihang; G19: Todar; G20: Siosemardeh.

First crop year: mean comparison for cluster groups

The mean comparison between the cluster analysis groups is shown in Table 1. The highest root length in the first group was 94.1 cm. Root length in the second and third groups did not differ significantly. The highest and lowest root DW was in the third and first group, respectively. RWC in the first group (79.09%) was as high as that in the second group (78.03%). The third cluster had the lowest relative water content (76.07%) and the highest biologic yield (728.6 g/m^2). The biological yield was lowest (656.1 g/m^2) in the third group. The highest and lowest HI was observed in groups 3 and 1, respectively. Spikelet per panicle was highest (13.93) in the third group and lowest in the first group (13.04). In addition, the highest and lowest number of panicles was observed in the third and first groups (13.93 and 13.04, respectively). The results of the mean comparison showed that the highest number of panicles was in the first group (487.45/m^2) and lowest in the second group, which was not significantly different from the third group. The highest 1000-grain weight was observed in the first group (27.66 g) and the lowest in the third group, which was not signifi-

Table 1. Mean comparison between different groups of cluster analysis based on different studied traits at two crop years.

Group	Root length	Root dry weight	Relative water content	Biologic yield	Harvest index	Spikelet per panicle	Number of panicles	1000-grain weight	Number of grains per spikelet	Number of grains per panicle	Number of grains per m^2	Radiation use efficiency	Grain yield
	First year												
G1	94.10 a	2.24 c	79.09 a	656.15 c	0.25 c	13.04 c	487.45 a	27.66 a	1.04 c	13.58 c	6242.35 c	2.36 b	173.40 b
G2	89.52 b	2.33 b	78.03 ab	689.09 b	0.28 b	13.47 b	446.27 b	25.57 b	1.27 b	17.17b	7475.07 b	2.73 a	191.22 b
G3	89.81 b	2.55 a	76.07 b	728.68 a	0.32 a	13.93 a	452.87 b	24.94 b	1.43 a	19.88 a	8849.41 a	2.75 a	219.87 a
CV (%)	12.5	23.3	3.58	9.67	16.7	14.8	20.3	16.2	14.4	19.8	12.8	14.2	18.7
	Second year												
G1	87.81 b	1.99 c	85.15 a	964.38 b	0.30 a	13.26 a	502.59 b	30.85 ab	1.54 b	20.51 b	9555.27 b	2.69 a	290.34 b
G2	85.30 c	2.28 b	85.30 a	1038.41 a	0.30 a	14.37 a	495.98 b	27.26 b	1.67 a	23.97 a	11699.66 a	2.57 b	315.40 a
G3	93.00 a	2.76 a	81.35 b	940.00 b	0.28 b	9.50 b	668.25 a	32.96 a	1.24 c	11.80 c	7930.40 c	2.54 b	253.75 c
CV (%)	12.32	24.85	2.84	8.86	4.68	15.36	21.21	13.65	14.01	22.08	12.9	9.47	11.52

At α=5% based on LSD, means with similar letters in each column are not significantly different.

cantly different than the second group. The highest number of grains per spikelet was observed in the third group (1.43) and the lowest in the first group (1.04). The highest number of grains per panicle was observed in the third group (19.88) and the lowest in the first group (13.58). The highest and lowest number of grain per square meter was for the third (8849.41/m^2) and first (6242.35/m^2) group, respectively. The rate of RUE was similarly high in the second and third groups, and lowest in the first group. Grain yield was highest in the third group (219.87 g/m^2) and lowest in the first group (173.4 g/m^2), which was not significantly different than the second group (191.22 g/m ^{2}).

Second crop year: mean comparison for cluster groups

Based on the results of the mean comparison between different groups, the highest root length was observed in the third group (93.0 cm) and lowest in the second group (85.3 cm; Table 1). The highest and lowest RDW was observed in the third (2.76 g) and first (1.99 g) group, respectively. The highest RWC was observed in the second group (85.3%), which was not significantly different than the first group (85.15%), and the lowest in the third group (81.35%). The highest biologic yield was in the second group (1038.41 g/m^2) and the lowest in the third group (940.0 g/m^2), which was not significantly different than the first group (964.38 g/m^2). There was no difference between the first and second groups in terms of HI, which was 30% in both groups. The lowest HI (28%) was observed in the third group. The highest spikelet per panicle was in the first and second groups (14.37), and the lowest in the third group (9.5). The highest number of panicles was in the third group (668.25) and the lowest in the first (502.59) and the second (495.98) groups. The highest 1000-grain weight was seen in the third group (32.96 g) and the lowest in the second group (27.26 g). The number of grains per spikelet was highest in the second group (1.67) and lowest in the third group (1.24). The highest number of grains per panicle was in the second group (23.97) and was lowest in the third group (11.80). The number of grains per square meter was highest in the second group (11699.66/ m^2) and lowest in the third group (7930.40/m^2). The rate of RUE was highest in the first group (2.69) and lowest in the second and third groups (2.57 and 2.54, respectively). The grain yield was highest in the second group (315.40 g/m^2) and lowest in the third group (253.75 g/m^2).

Principal component analysis

The results of the PCA based on all traits are shown in Table 2. In the first year there were 3 components with eigenvalues greater than 1: the first, second and third components had eigenvalues of 5.65, 3.14 and 1.22, respectively. Together, these 3 components accounted for 77.13% of the total variance. Individually, the first, second and third components had a relative variance of 43.5%, 24.20% and 9.42%, respectively. For the first component, the traits with the highest load factor included RDW, RWC, biologic yield, HI, spikelet per panicle, number of panicles, 1000-grain weight, RUE and grain yield. For the second component, the traits with the highest load factor were the number of grains per spikelet, the number of grains per panicle and the number of grains per m^2. Root length had the highest factor load in the third component.

The results of the PCA based on all the traits were slightly different in the second year. The first 3 components with an eigenvalue greater than 1 were 5.35, 2.38 and 1.7, respectively. In total, the 3 components contributed to 72.60% of the total variance. The first component had the highest variance (41.15%) and the second and third had variances of 18.34% and 13.10%, respectively. In the first component, the traits with the highest load factor were RDW, RWC, spikelet per panicle, the number of panicles, 1000-grain weight, the number of grains per spikelet, the number of grains per panicle and the number of grains per m^2. In the second component, the traits with the highest load factor included biologic yield and grain yield. In the third component, RDW, HI and 1000-grain weight had the highest load factor.

Based on the bi-plot chart of the first year (Fig. 1), genotypes G14, G16, G17, G13, G15, G7 and G8 formed one group. Moreover, grain yield, biologic yield, RUE, HI, number of grains per m^2 and the number of grains per spikelet were classified into 1 group, which was strongly associated with genotypes G14, G16, G17, G13, G15, G7 and G8. Genotypes G11, G9, G3, G2 and G4 formed another group, which was strongly related to the number of grains per panicle and spikelet per panicle. Genotypes G10, G6, G12, G5 and G1 formed an adjacent group and were associated with the relative water content. Genotypes G20, G18 and G19 formed 1 group based on the first and second components, and had a strong association with root length, RDW, the number of panicles and 1000-grain weight.

The results of the bi-plot were somewhat different in the second year. Genotypes G8, G9, G7, G10 and G12 formed one group, which was strongly associated with grain yield, the number of grains per m^2, the number of grains per spikelet, spikelet per panicle and the number of grains per panicle. Genotypes G11, G17 and G14 formed another group that was strongly associated with biologic yield, RUE, 1000-grain weight and the number of panicles. RDW, RWC and HI formed 1 group that had a strong relationship with genotypes G1, G2, G3, G4, G5, G6, G13 and G16.

DISCUSSION

Based on the meteorological results, rainfall was lower and temperature was higher in the first crop year as compared to the second year. Therefore, the higher yields in the second year of cultivation may be the

Table 2. Results of principal component analysis based on different studied traits in two crop years.

Number of traits	Traits	First year			Second year		
		PC1	PC2	PC3	PC1	PC2	PC3
X1	Root length	0.271	-0.161	0.737	-0.270	-0.431	-0.190
X2	Root dry weight	0.710	-0.078	0.312	-0.636	0.169	-0.615
X3	Relative water content	-0.771	-0.103	-0.233	0.876	-0.131	0.097
X4	Biologic yield	0.723	0.211	0.182	-0.211	0.889	-0.163
X5	Harvest index	0.704	0.462	-0.144	0.335	-0.097	0.544
X6	Spikelet per panicle	-0.760	0.358	0.445	0.829	0.100	0.124
X7	Number of panicles	0.826	-0.437	-0.022	-0.906	0.072	-0.203
X8	1000-grain weight	0.817	-0.334	-0.267	-0.630	0.178	0.684
X9	Number of grains per spikelet	0.112	0.859	-0.352	0.783	0.143	-0.224
X10	Number of grains per panicle	-0.446	0.876	0.073	0.972	0.157	-0.082
X11	Number of grains per square meter	0.341	0.858	0.134	0.585	0.543	-0.455
X12	Radiation use efficiency	0.603	0.304	0.188	-0.376	0.490	0.230
X13	Grain yield	0.921	0.288	-0.156	0.026	0.852	0.342
	Eigenvalue	5.656	3.147	1.225	5.350	2.384	1.704
	Relative variance (%)	43.507	24.208	9.420	41.155	18.340	13.108

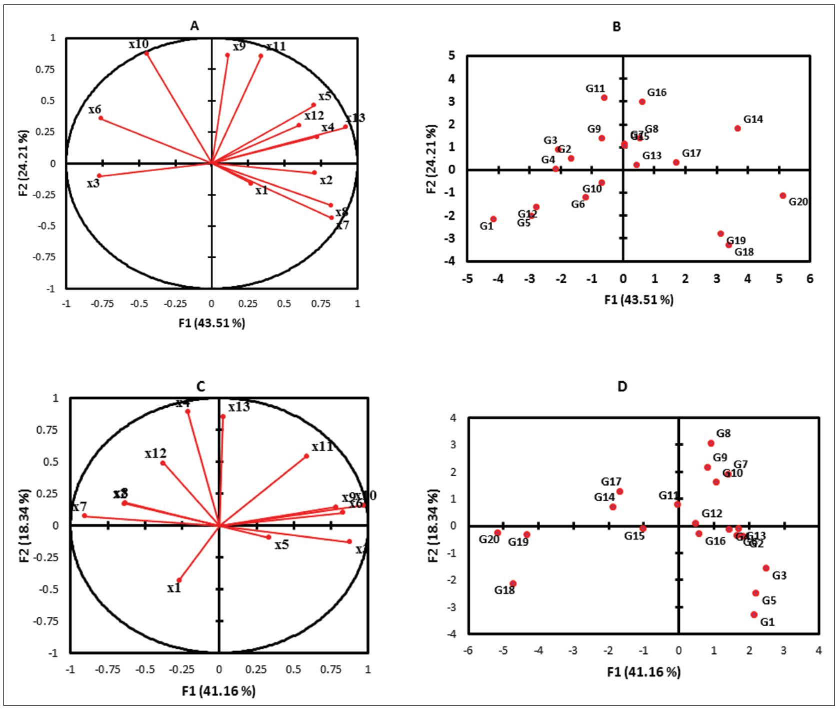

Fig. 2. Biplot of the first and second components at different crop years related to different wheat genotypes. **A** and **B** – first year; **C** and **D** – second year. X1: Root Length; X2: Root dry weight; X3: Relative water content; X4: Biologic yield; X5: Harvest index; X6: Spikelet; X7: Number of panicles; X8: 1000-grain weight; X9: Number of grains; X10: Number of grains; X11: Number of grains (m^2); X12: Radiation use efficiency; X13: Grain yield; G1: 3; G2: 12; G3: 18; G4: 9; G5: 15; G6: 17; G7: 11; G8: 25; G9: 30; G10: 36; G11: 45; G12: 48; G13: 2; G14: Azar-2; G15: Karim; G16: Cross sabalan; G17: Rizhab; G18: Avihang; G19: Todar; G20: Siosemardeh.

result of increased precipitation – and hence water availability – during the plant growth period. Moreover, higher temperatures can lead to more evapotranspiration, which could expose the plant to higher tension. Indeed, many researchers have shown that drought stress causes loss of yield [16,17].

As the moisture content of the soil decreases, this leads to protoplasm release along with reduced cell swelling; cell size and cell division rate tend to decrease dramatically, resulting in a decrease in the growth and photosynthetic rate of the plant [18]. Water deficit affects not only the dry weight of the plant but also reduces the number of seeds and panicles [19]. Moreover, drought stress conditions cause the plant to produce a cellular inflammation response [18]. Therefore, drought conditions increase metabolic activity, growth rate and developmental rate of the root, such that the root increases the absorption of nutrient ions. In addition, by increasing the turgor, the energy available through photosynthesis also increases [20]. Taken together, this highlights that under drought stress and suboptimal conditions of cellular inflammation, the distribution of food to the root is increased compared to the stem, hence the plant will not be able to provide the carbohydrates needed for continued growth.

The effects of traits on grain yield in the second year were not similar to those of the first year, likely because of the improved environmental conditions (higher precipitation and lower temperatures). In drought stress conditions (the first crop year), the HI had a positive correlation with grain yield, though this was not the case under normal conditions (the second crop year). This could indicate that plants prefer to invest in seed yields under stress conditions in order to increase the chances of survival of the next generation, which would explain why the HI was high under stress conditions [21]. By increasing the amount of relative water content, the apertures of the plant could open more causing water loss. This would ultimately reduce the grain yield. This result was not observed in the second crop year when the amount of water was not limited. Increasing the amount of RWC also increases the amount of CO_2 available to the plant, resulting in higher photosynthetic production. In general, the RWC was lower in low-stress conditions (first year of cultivation) compared to normal conditions (second year of cultivation). A number of researchers have shown that exposing plants to drought stress causes reduced stomatal conductance and subsequently the RWC and photosynthesis also decreases [22,23]. A sharp decrease in stomatal conductance with little variation in RWC indicates that rooting signals from drought stress conditions are the cause of stomatal closure and decreased photosynthesis. This chemical signal is the same as abscisic acid [24]. In another study, Ouyang et al. [25] observed that stressed plants had significantly lower stomatal conductivity than irrigated plants, which reduced leaf transpiration in drought conditions. In addition to the production of abscisic acid in the root and its transfer to the leaves, the closure of stomata under stress conditions also reduces the potential for inflammation in the leaf, and is likely to be effective through the production of abscisic acid produced in the leaf itself [26].

Correlation analysis revealed a significantly positive correlation between grain yield and RDW that was likely the result of the plant improving its root system in drought conditions (the first crop year), hence increasing its dry weight. Ideally, the drought-tolerant plant would devote more of its photosynthetic production to the accumulation of dry matter in the root to preserve material in the stem and areal part, since it will retain its ability to absorb more water from the soil [27]. Considering that one of the main methods used by plants against drought stress is to increase RDW, this trait can be a suitable criterion for identifying tolerant genotypes from susceptible genotypes [28]. The groups that had high yield under drought stress conditions (the first crop year) correlated with root length, hence the genotypes with lower root length obtained higher yields. In addition, RDW was found to be higher in this group than in other groups. It seems that under stress conditions, tolerant genotypes obtained a higher yield by increasing RDW and decreasing root length.

In the second year, RDW was not positively correlated with yield because there was no moisture content in the second year, hence the plants were not required to invest in the root system. Researchers have shown that there is a positive and significant relationship between RDW and grain yield of plants under water deficit conditions [20,29,30]. However, the RUE differed between the first and second crop years. Moreover, the use of light in different wheat genotypes was different. It seems that the difference in photosynthetic efficiency of cultivars can differentiate the behavior of cultivars in different weather conditions, consistent with the results of several other researchers [31,32]. Sinclair and Muchow [33] reported that the effect of light consumption is more influenced by plant genetics. We observed high variation in the efficiency of light consumption among different genotypes.

Biplot results of the first crop year showed that the high-yield genotypes, including G14 (263.00 g/m^2), G20 (264.50 g/m^2), G18 (214.00 g/m^2) and G19 (222.50 g/m^2), were more strongly correlated with traits x4, x13, x12, x5, x1, x7, x8, x2 and x10. This result indicates that high yield in drought stress conditions can be achieved by improving these traits. In the second year of cultivation, the high-yield genotypes included G7 (356.42 g/m^2) and G9 (356.75 g/m^2), which were highly correlated with x11 trait. These results indicate that under stress conditions – as in the first crop year – more traits play a role in contributing to the grain yield of wheat. In addition, the superior genotypes demonstrated the highest rates of RUE in yield, suggesting the importance of this trait. Specifically, the mean RUE rate in the first (2.64) and second (2.61) years showed that wheat genotypes had higher RUE in stress conditions. Indeed, the amount of light absorbed and the dry matter produced by plants has been shown to be reduced in drought stress conditions [34]. Under drought stress conditions, reduced water availability decreases cell growth and subsequently reduces the leaf area index, the proportion of dry matter and consumption of light [35]. Nevertheless, the biplot results highlight that RUE is not the only effective factor in grain yield among the superior genotypes. Overall, grain yield is dependent on many additional factors to induce stress tolerance.

CONCLUSION

Our results revealed a high degree of variation between different wheat genotypes in terms of how their traits responded to drought stress conditions. Moreover, the various wheat genotypes were exposed to different weather conditions in the first and second crop years, grain yield and other measured traits were also influenced by the environment. In the first year of cultivation, there were 4 genotypes (G14, G20, G18, and G19) that had the highest yield (263.00 g/m^2, 264.50 g/m^2, 214.00 g/m^2, 222.50 g/m^2, and 222.50 g/m^2, respectively), and are suitable for cultivation in a drought-exposed environment. Results from the PCA showed that the traits x4, x13, x12, x5, x1, x7, x8, x2 and x10 had a strong association with these 4 genotypes. In the second year, 2 different genotypes (G7 and G9) had higher yields (356.42 g/m^2 and 356.75 g/m^2, respectively), and are suitable for cultivation in normal conditions. PCA showed that the trait x11 was strongly related to these genotypes. Overall, the quantitative traits screened here can be used to improve the grain yield of wheat genotypes in future breeding programs.

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Author contributions: Ali Jamali designed, performed the experiments and wrote the manuscript. Yousef Sohrabi, the corresponding author, supervised the experiments and managed the design, writing and revision of the manuscript. Adel Siose Mardeh performed the data analysis. Farzad Hoseinpanahi contributed to the draft of the manuscript.

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Supplementary Material

The Supplementary Material is available at: http://serbiosoc.org.rs/NewUploads/Uploads/Jamali%20et%20al_4852_Supplementary%20Material.pdf