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Research Article

In-vitro screening for drought tolerant wheat (*Triticum aestivum* L.) cultivars at early seeding stage

Muhammad Akhtar[1], Maksat Batyrbek[2], Saba Ambreen Memon[3], Muhammad Saleem[4], Rimsha Larik[5], Ahmed Elsayed Abdelghany[6], Muhammad Anwar[7*]

1 Department of Agronomy, Faculty of Agriculture Sciences & Technology, Bahaudin Zakariya University, Multan
2 Department of Soil Science and Agro-Chemistry, Kazakh Research Institute of Agriculture and Plant Growing, Kazakhstan
3 Department of Horticulture, Faculty of Crop Production, Sindh Agriculture University, Tandojam, Sindh Pakistan
4 College of Biosciences and Biotechnology, Yangzhou University, Jiangsu, China
5 National Centre of Excellence in Analytical chemistry University of Sindh Jamshoro Sindh Pakistan
6 College of Water Resources and Architecture Engineering, Northwest A & F University, Yangling, China.
7 College of Life Sciences and Oceanography, Shenzhen University P.R China.
* Correspondence: anwar_uaar@yahoo.com

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Abstract | In general, the plant's growth period after seed germination is quite susceptible to water shortages. Experiment was set up under controlled conditions with replication thrice in CRD with four treatments with T1 distilled water (control T20.5, T3 0.75, and T41.0 Megapascal MPa), where six wheat varieties were examined combined. Seeds of various wheat cultivars were cultured in Petri plates with various concentrations of (PEG 6000) solution to induce an osmotic stress state and assess its impact on seed germination in percent. As the water potential of the medium declined, the germination percentage, the length of the shoots, and the length of the roots of the wheat seeds all reduced. In 120 hours, all forms of water absorption attained their maximum value under all water stress circumstances. Under water stress, the IBWSN1010 and IBWSN 1025 types had a higher germination rate than other wheat varieties. The maximum seed germination decreases recorded at high water stress level PEG 6000 (1.0 MPa) were considerably reduced (P 0.01), according to the analysis of variance and variance.

Keywords | Germination; Wheat; PEG 6000; Water stress; Mega Pascal (MPa)
Keyfindings | Keyfinding must be one paragraph and contaning the whole summary of research work

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1. Introduction

One of the biggest environmental issues is the lack of fresh water, which is a worldwide constraint that hinders plants from living in arid regions (Nemat et al., 2015). Surbhaiyya and friends (Surbhaiyya et al., 2018). The whole world's population will be subjected to severe water scarcity by 2025, when there will be total water scarcity (Surbhaiyya et al. 2018). Crop output is affected by drought, and the intensity of the condition affects all stages of plant growth. Coleoptile germination ability, length, and vitality are also reduced (Farooq et al., 2009 Moullef et al., 2018). The second-most significant grain crop in Pakistan is wheat (Triticum aestivum L.) (Arain et al., 2011 and Anwar et al., 2011). With a total area of 9,046 million hectares and an annual production of 24,032 million tonnes, wheat is a significant staple food crop in Pakistan (Sial et al., 2012). Plants that can withstand drought can be produced using mannitol or polyethylene glycol (PEG) (Piwowarczyk et al., 2014. Moullef et al., 2018). The main effects of a lack of water in cells include reduced water potential, increased chemical concentrations, osmotic adaptation, and changes in macromolecule structure and conformation (Yadav and Srivastava, 2017). In the early phases of seedling growth, drought resistance is frequently chosen for using simulated drought produced by chemicals such (PEG 6000). To increase wheat output, it is essential to identify wheat varieties that perform better under water stress. Examining the character organisation for early seedling characteristics of many wheat varieties under water-stressed circumstances is necessary to comprehend the factors that restrict yields. This study's objective was to identify wheat cultivars that can survive osmotic stress brought on by PEG.

2. Materials and Methods

The Department of Bread and Plant Genetics at the Nuclear Institute of Agriculture (NIA) Tandojam was the source of the six cultivars or lines used in the laboratory trial (Latitude: 25.433, Longitude: 68.533). A controlled experiment was carried out using three complete randomised design (CRD) replications. Six different wheat cultivars were included in our study trail (IBWSN1010, IBWSN1025, TD1, ESW9525, plus two local controls Khirman and chakwal86). experiment layout For the first 10 mints, we washed the seeds of six different varieties of wheat with 5% sodium hypochlorite (NaOCl), followed by three rinses with distilled water. The Department of Bread and Plant Genetics at the Nuclear Institute of Agriculture (NIA) Tandojam was the source of the six cultivars or lines used in the laboratory trial (Latitude: 25.433, Longitude: 68.533). A controlled experiment was carried out using three complete randomised design (CRD) replications. Six different wheat cultivars were included in our study trail (IBWSN1010, IBWSN1025, TD1, ESW9525, plus two local controls Khirman and chakwal86). experiment layout For the first 10 mints, we washed the seeds of six different varieties of wheat with 5% sodium hypochlorite (NaOCl), followed by three rinses with distilled water.

Statistical analysis: The LSD test was used to compare the means in accordance with the Gomez and Gomez (1984) technique, and the results were subjected to analysis of variance to see if treatment means were superior.

3. Results

Six different varieties of wheat were tested in an in vitro experiment to examine how well they could survive water stress brought on by PEG (6000) during the early seedling period. Six different wheat cultivars responded differently to various PEG treatments, according to the statistical analysis. Information on the proportion of seeds that germinate under stress caused by PEG and the lengths of the shoots and roots (in cm) (Table 1).

3.1. Seed germination under PEG stress

In this work, PEG (6000) was used to create chemical water stress on the six cultivars during the early phases of seedling growth in a controlled environment (Fig 1). Six different wheat varieties' seeds germinated after 120 hours at various PEG concentrations (0, -0.5, -0.75, -1.0Mpa). Water stress decreased down seed germination. The drop was bigger than 1.0 MPa, followed by 0.75, 0.5, and the control, with the corresponding mean values for seed germination being 67.77, 88.33, 92.22, and 99.44 percent. Under regulated conditions, the genotypes IBWS1010, IBWS1025, TD1, ESW9525, and Chakwal86 showed maximal seed germination (100 percent), however a germination rate of 96.66 percent was discovered in Khirman. According to (Chachar et al., 2016), several wheat cultivars' germination percentage reduced as moisture stress rose. When employing the greatest PEG concentration (6000) (-1.0 Mpa), the cultivars Chakwal-86 and Khirman also had the highest seed germination percentage (98.33 and 95 percent , respectively). On the other hand, ESW-9525 had the lowest germination rate (40%) when subjected to severe water stress (-1.0 MPa). Our research on wheat cultivar germination under PEG-induced conditions with retraining in wheat cultivar germination produced results that are entirely similar with those found by others (Mirbahar et al., 2013; Chachar et al., 2016; Surbhaiyya et al., 2018).

3.2. Shoot length (cm)

The effects of PEG (6000) stress on the shoot length of several wheat cultivars are depicted in Figure 2. The -1.0mpa concentration resulted in the shortest shoot length when compared to the control condition. It is known that seedlings may grow in the lab, thus it is reasonable to believe that when PEG levels are high enough to inhibit the growth and survival of wheat seedlings, a suitable growth stage for assessing wheat's drought resistance occurs. In our study, shorter shoots were seen when PEG content was raised. While a PEG-induced controlled environment is being used (Surbhaiyya et al., 2018). As the amount of PEG 6000 was raised, it was discovered that the length of the shoots of several different wheat cultivars drastically decreased. The length of the shoots of various genotypes varies as a result of the variable osmotic potential of PEG. The maximum value of shoot length was recorded for IBWSN1010 (16.68 cm), while the lowest value (12.88 cm) was reported for the TD1 variety, followed by IBWSN1025 (13.93 cm), and ESW9525 (15, 86 cm), when compared to local controls Khirman & chakwal86 (17.12, 16.22 cm). After treatment with high PEG (1.0 MPa), ESW9525 (4.09 cm) had the longest shoots, followed by the variants IBWSN1010 (5.29 cm) and IBWSN1025 (5.06 cm), whereas TD1 (TD1) had the smallest shoots (9.68 cm). Both Chachar et al. (2014a, 2014b) and Mirbahar et al. (2013) discovered that shoot length reduced as osmotic stress rose.

3.3. Root length (cm)

In our study, the wheat genotype ESW9525 displayed the greatest root length (12.04 cm), while the greatest root lengths were observed for the wheat genotypes IBWSN1010 (10.62 cm), IBWSN1025 (8.98 cm), and TD1 (5.34 cm) in comparison to local control truths Khirman and chakwal86 (12.92, 12.92) under control treatment. As shown in FIG., the wheat genotype IBWSN1010 (4.83 cm) had the smallest root length after being subjected to 1.0 MPa PEG6000, whereas the wheat genotype TD1 (8.67 cm) had the longest root length. Additionally, studies have revealed that root length is reducing and that water stress has a significant effect on root length (Chachar et al., 2016; Chachar et al., 2014a, 2014b).

Table 1. Mean squares from analysis of variance for various morphological traits of wheat cultivars at seedling stage under osmotic stress (PEG 6000).

Source of variation	MORPHOLOGICAL CHARACTERS			
	DF	Seed germination %	Shoot length	Root length
Replication	2	114.93	0.11	2.47
Treatments	3	3320.37**	201.97**	128.22**
Genotype	5	1220.56**	32.86**	31.49**
Genotype x treatment	15	622.04**	12.24**	10.93**
Error	40	28.96	1.45	3.99

**= significant at P<0.01probability level, *= Significant at P<0.05probability level and ns. = Non-significant

1

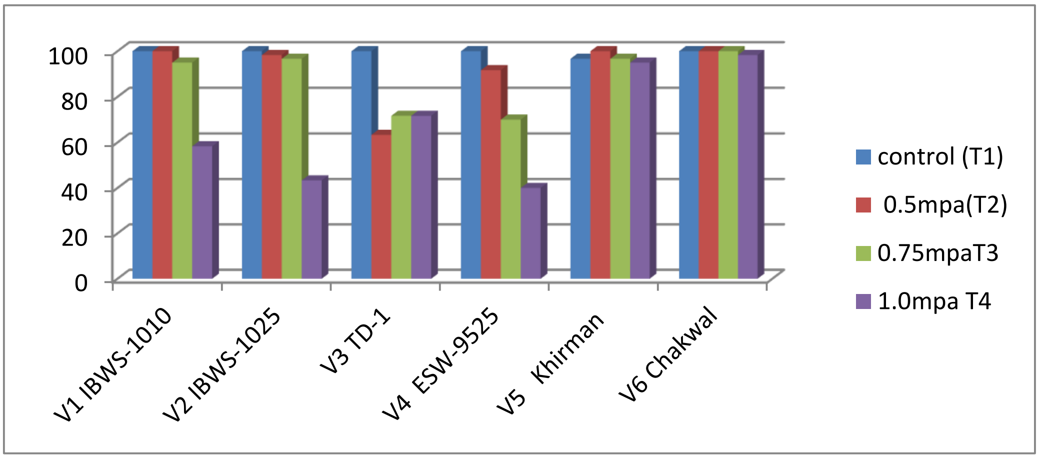

Figure 1. Effects of PEG on seed germinations of different wheat cultivars

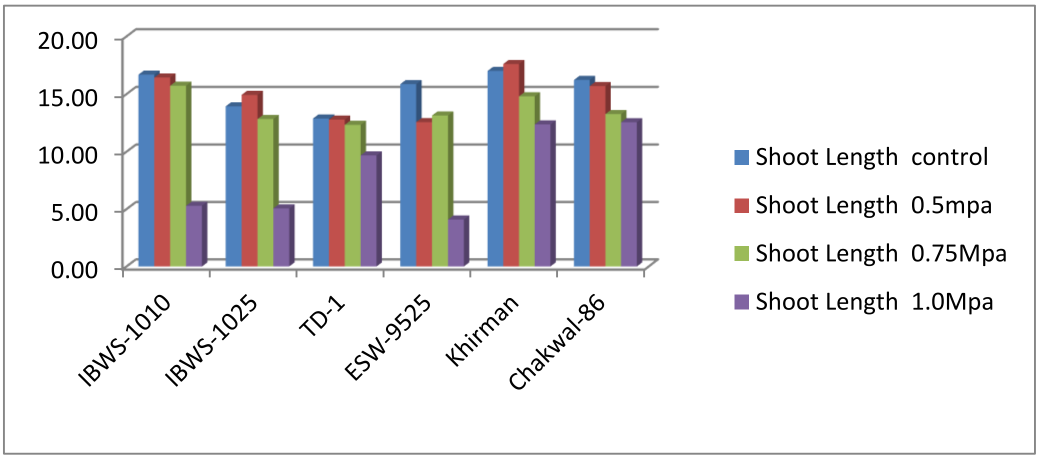

Figure 2. Effects of PEG on shoot length of different wheat cultivars

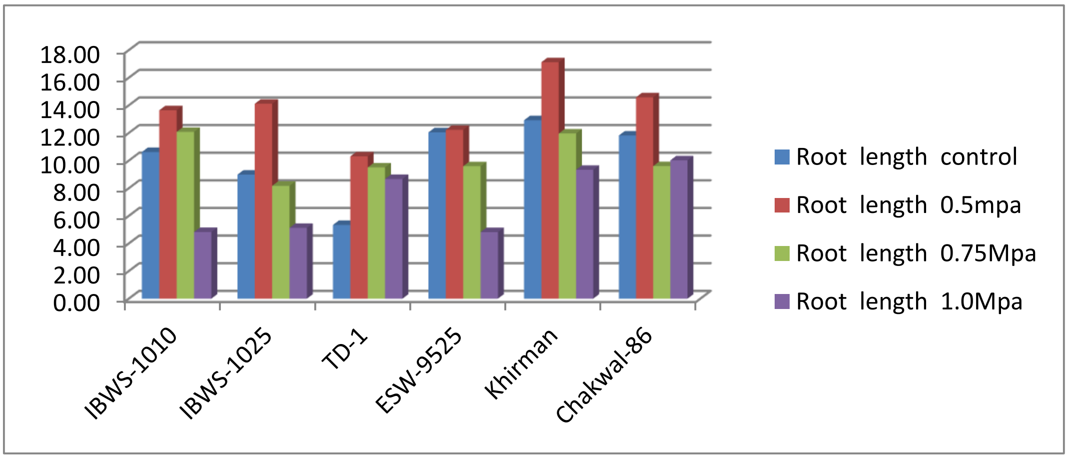

Figure 3. Effects of PEG on root length of different wheat cultivars

4. Conclusions

We investigated and assessed the genetic potential of six different wheat cultivars using the chemical polyethylene glycol (PEG) 6000 in controlled environments. The cultrivars ESW9525 and IBWSN1010 are the most drought-tolerant varieties, according to the current study trail. Since the desired qualities were shown to be superior, it is advised that the findings may be helpful and successful for wheat drought stress selection and may also be useful for other breeding initiatives including drought tolerance.

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Conflicts of Interest: The authors declare no conflict of interest.

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