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Study of the Tolerance to Drought Stress Levels of (PEG 6000) in Different Genotypes of Wheat Germination Stage

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ABSTRACT- Germination one of the most important stages of development, the basic requirement for having the proper density is farm. In order to choose wheat lines tolerant to drought during seed germination factorial experiment in a randomized complete block design with three replications were run Agricultural Research Center in Tehran. The treatments included 40 genotypes of wheat and different levels of PEG (zero 3- 6- and 9-charge time). Traits such as root length, coleoptile length, stem length, the root / shoot ratio, root dry weight and the percentage of germination rate were measured. The results showed that all traits of drought stress significantly reduced the decline in all the traits of a potential change of 3 bar to 6 bar, and the results showed that the root length of shoot length other traits for drought levels was significant, but the interaction was not significant cultivar × drought. With increasing stress, most traits are reduced, the minimum impact of drought on the root to shoot ratio and root dry weight was the most affected.

Key-words- Germination, Osmotic stress, Polyethylene glycol, Wheat, Genotype

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INTRODUCTION

More than 80 years of corrective actions that lead to a relative increase crop yield in arid environments, it passes though the basic research, the results are significant in understanding the molecular and physiological reactions of plants to provide water shortages but it is there is a huge gap between performance and stress conditions. To minimize the performance gap and increase its stability under various conditions of stress, food security is of strategic importance [1]. Stresses non-living as the main source (71%) reduction performance are the total potential yield loss by stress non-living, 17% of the land, 20% salt, 40% high temperature (heat), 15% is the low temperature and 8% for other factors [2].

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Wheat germination and emergence stage and late season drought stress faced by the numbers so that in addition to drought tolerance in germination and emergence stage is high-performance of the utmost importance [3].

Reports indicate that genotypes during germination that can show an appropriate response to drought stress, better growth at seedling stage and have produced a stronger root system [4]. Twenty genotypes of wheat for drought tolerance in field conditions and laboratory reported that drought tolerant genotypes of drought tolerance in field conditions were the *in vitro* germination stage [5]. In a study related parameters such as length of coleoptile plant growth, root length, and shoot length as outstanding traits for tolerance to drought were [6].

Seed germination and strong stamina is important for the initial deployment. Seedling growth is limited by lack of moisture in dry areas in the region and the establishment of seedlings greatly speed processing time and performance [7]. Has a different screening procedures at this stage to improve drought resistance is provided. A number of efficient methods for this purpose include density and root, root to shoot ratio, early plant vigor, leaf relative water content, membrane stability and germination under stress conditions [8].

In studies of the response of plants to drought stress as the creation and maintenance of water potential in the soil, so it is difficult to simulate osmotic stress using different materials to create the desired osmotic potential is very popular and one of the most important methods to study the effects of drought is seen on germination [9]. The classification of wheat varieties with different levels of resistance to drought by mannitol germination stage, it is reported that drought stress decreased root and shoot length, but the root to shoot ratio increased dramatically increases stiffness ratio root to shoot for drought tolerance trait is a good resolution [10]. The effect of drought on wheat, germination vigor compared to the shoot, germination and root length sensitive to drought stress introduced trait [11]. In another study it was found that a high proportion of root length to shoot is showing more tolerance, but due to the different reaction of potential traits of different genotypes seem to classification and screening genotypes for drought tolerance should use multiple-choice criteria and the use of an adjective in the presence or absence of tolerance avoided [10]. Due to the importance germination and early plant establishment objective of this study was to examine the components of germination response to different levels of water stress (PEG) as the bread wheat genotypes.

MATERIALS AND METHODS

This research was conducted in Agriculture and Natural Resources Research and Education Center of Tehran Province factorial experiment in a randomized complete block design with three replications. The treatments were 40 bread wheat. To evaluate resistance to drought during seed germination and establishment of different levels of osmotic potential of polyethylene glycol 6000 was used. Different concentrations of polyethylene glycol 6000 were prepared according to [12].

$$\mathbf{QS= (1018 \times 10\text{-}2)\, C - (1018 \times 10\text{-}4)\, C_2 + (2067 \times 10\text{-}4)\, CT + (8039 \times 10\text{-}7)\, C_2T}$$

Whereas, QS= Osmotic potential in terms of polyethylene glycol concentration in grams per liter load, C and T-Temperature in degrees C distilled water was used to create zero load.

Total petri-dish and seedbed (What man paper) and medium ready to transfer the containers were autoclaved 25 seed numbers randomly selected for each petri dish and anti-surface disinfection using sodium hypochlorite seeds 5/2 the percentage was 15 minutes. Seeds after washing three times with distilled water, separate the layers were dry sterile filter paper and then the amount of the solution was added to each of them. Registration germination for certain hours of the day and the second day was started and continued until the eighth day. Root out the size of 2 mm or more was considered as a measure of germination. At the end of the experiment (day eight) 10 seedlings randomly selected from within each petri root length, shoot undertaken pursuant cm were measured with a ruler. Seedling at 60° C for 48 hours and then put it in dry weight was measured with sensitive scales. The following formula was used to calculate the percent germination [13].

$$\mathbf{PG= NI/N \times 100}$$

In this equation, germination, NI, the number of germinated seeds until the day I and N is the total number of seeds.
The following equation was used to calculate the germination rate:

$$\mathbf{RS=\sum_{i-1}^{N} \frac{SI}{Di}}$$

In this equation, RS, germination rate, SI number of germinated seeds per day and D, the number of days elapsed since the start of the experiment.

RESULTS AND DISCUSSION

Experimental results Table 1 shows that between genotypes and traits of drought stress during the shoot, root length, length of coleoptile and root to shoot ratio, speed and germination, root dry weight and fresh weight were significant differences in the level 1 percent there were. The results showed that the ratio of root to shoot, other traits in water levels was significant, but the interaction was not significant cultivar × drought.

Germination

The mean percentage of germination Table 2 shows that increasing water stress decreased germination percentage and average percent germination under normal conditions in drought stress conditions (-3 and- 6 bar) was more. The data, Table 2 genotypes 38% and 5% with an average of 5.92 and 3.27 were the highest and lowest percentage of germination. Reduction in germination parameters can be slow initial uptake of water. Drought by limiting the absorption of water by the seeds, the impact on the movement of seed swapping and direct impact on protein structure affected fetal germ [8]. Reduce the percentage of germination of wheat under drought stress sensitivity of plants to drought stress, which represented about by Saeidi *et al*. [3] and Azizinia *et al.* [9] have been reported.

Germination rate

By reducing the osmotic potential of up to 6 times the speed of germination rate fell 17.1%, according to data Table 2 with an average of 5.37 and 1.58 genotypes 39 and 5 days, respectively, the highest and the speed of germination. The important characteristics of crop plants capable of responding to changes in moisture through their roots to the rapid growth of available moisture and germination speed fast that the lines due to the rapid germination rate but the lines were incurred as a result of favorable or the results [10,14] and germination is slow because stress increases the osmotic pressure of the environment in which case the seed or plant root water uptake by seed or root cause of a problem. Reduce the percentage and rate of germination with increased drought in many plants, especially cereals had been reported.

Slow germination done because of reduced water potential and reduced availability of seeds linked to water as well as access to water by reducing the osmotic potential seed (soluble) and matric (suction) decreases. The water potential environment has a direct impact on the rate of water absorption and germination. The water potential environment has a direct impact on the rate of water absorption and germination [3,9].

Table 1: Analysis of variance for 40 genotypes of wheat and 3 levels of polyethylene glycol in laboratory conditions

SOV	DF	Plumule length	Coleoptile length cm	Root lengthcm	Root length/ shoot	Germination (rat)	Germination (%)	Root fresh weight (g)	Root dry weight (g)
Repetition	2	516.39**	129.14**	368.17**	68.42**	10.34**	605.68**	1.027**	0.60**
Genotypes	39	9.37**	5.66**	8.42**	3.98**	2.59**	26.40**	.038**	0.021**
Drought stress	2	13.2**	4.31**	17.05**	1.76ns	3.93**	72.56**	0.05**	0.01*
Stress× Genotypes	78.	2.29ns	1.11ns	1.99ns	1.12ns	0.934ns	18.00ns	0.009**	0.003
Error	238	2.044	1.21	2.91	1.38	0.7 ns	2078	0.009	0.006
Cv %		9.27	10.12	6.75	8.34	5.28	12.4	11.84	8.46

Ns,*and: Non significant and significant at 5% and 1% probability levels, respectively**

Length of root and shoot length

With increasing stress from zero distilled water (6 times), respectively to the root and shoot length 4.15% and 1.16% and the rate of decline due to increased stress during the shoot far more than the length of root Table 2. So the root because it is less affected by stress, can be as reliable in breeding programs and the data Table 2 genotypes 39 and 5 cm with an average of 7.06 and 2.60 respectively were the highest and lowest root length, as well as lines 39 and 5 with an average of 6.37 and 2 cm shoot length were the highest and lowest values. So the numbers were the highest number of seminal roots during germination, seed yield, and it became clear that extensive root system associated with drought tolerance. Root development is influenced by soil water potential. Drought stress decreased with the increasing root growth rate of root growth less than the growth of the aerial parts of the plant affected so that the whole shoot to root ratio decreased farmer [5]. Reduction in longitudinal growth of shoot and root length growth of the primary mechanisms in the face of stress that can genotypes that have more root growth on the supply of water to plants under drought stress conditions affect activity and protect the plant from the damaging effects of stress [7]. With increasing severity of drought to (9 times), because most of the components of germination could react, so stress levels (9 times) were removed from the test results.

Coleoptile length

With increasing severity of drought stress from zero times (6 times) was reduced during coleoptile Table (3). Genotypes 22 and 5 cm with an average of 4.40 and 1.93 respectively the highest and lowest coleoptile length. The results show that by increasing the coleoptile length, stem length on grain yield effective, so the root sheath and can be considered one of the characteristics of selectivity in dry areas. Varieties that have long leaf heath can be cultivated in greater depth and in greater depth and better use of water storage (4 and 3). It was reported by Balouchi *et al.* [7] seedling stage process is sensitive to drought stress. Studies show that having a long coleoptile situation improves seedling establishment under drought stress is a major factor in the eventual production plant.

Table 2: Comparison of different characteristicsto the surfaces of polyethyleneglycolin laboratory conditions

	MS								
	Treatments	**Plumule length**	**Coleoptile lengthcm cm**	**Root length cm**	**Root length/shoot**	**Germination (rat)**	**Germination (%)**	**Root fresh weight (g)**	**Root dry weight (g)**
	(0)	^{a}3.84	^{a}2.34	^{b}3.85	^{a}2.91	^{a}4.126	^{a}79.9	0.^{a}184	0.^{a}120
(PEG)	**(-3 bar)**	^{ab}3.5	^{ab}2.14	^{a}4.29	^{a}2. 8	^{ab}3.905	^{b}61.8	^{a}0.7167	0.^{ab}112
	(-6 bar)	^{b}3.20	^{b}1.97	^{b}3.1	^{a}2.67	^{b}3.76	^{b}66.2	0.^{b}141	0.^{b}09

Means followed by similar lettr are not significantly different at probability level

Table 3: Comparison of different characteristic for 40 genotypes bread wheat

Genotyp es	**Plumule length cm**	**Coleoptile length cm**	**Root length cm**	**Root length / shoot**	**Germina-tio n (rat)**	**Germina-tion (%)**	**Root fresh weight(g)**	**Root dry weight(g)**
1	2.57 $^{e-h}$	1.63 $^{f-g}$	3.86 $^{d-g}$	2.89 $^{a-e}$	4.06 $^{b-f}$	65.5 $^{b-c}$	0.09 $^{i-j}$	0.05 g-h
2	3.15 $^{e-h}$	1.55 $^{f-g}$	4.48 $^{d-c}$	3.00 $^{a-e}$	3.68 $^{d-f}$	65.5 $^{b-c}$	0.2 $^{e-g}$	0.1 c-h
3	3.33 $^{e-h}$	1.6 $^{f-g}$	3.87 $^{d-g}$	2.58 $^{d-h}$	3.97 $^{b-f}$	66.6 $^{b-c}$	0.13 $^{e-j}$	0.09 e-h
4	3.31 $^{e-h}$	1.93 $^{d-g}$	3.53 $^{d-c}$	2.24 $^{e-g}$	4.33 $^{a-d}$	71.1 $^{b-c}$	0.13 $^{e-j}$	0.08 e-h
5	2.00 ^{e}	1.38 ^{g}	2.06 ^{g}	1.29 ^{h}	1.85 ^{g}	27.3 ^{c}	0.13 $^{e-j}$	0.05 $^{e-h}$
6	3.46 $^{e-h}$	1.90 $^{d-g}$	5.15 $^{d-g}$	2.85 $^{b-g}$	3.95 $^{b-f}$	61.1 $^{b-c}$	0.17 $^{d-i}$	0.14 $^{b-c}$
7	3.33 $^{e-h}$	1.78 $^{d-g}$	4.55 $^{d-g}$	2.48 $^{f-g}$	4.04 $^{b-f}$	63.3 $^{b-c}$	0.05 ^{j}	0.13 $^{c-g}$
8	2.85 $^{e-h}$	1.44 ^{g}	3.81 $^{d-g}$	2.76 $^{b-c}$	4.57 $^{a-b}$	71.1 $^{b-c}$	0.15 $^{e-j}$	0.11 c-h
9	3.8 $^{c-g}$	2.95 $^{b-c}$	4.71 $^{d-g}$	2.34 $^{f-h}$	3.69 $^{d-f}$	71.1 $^{b-c}$	0.21 $^{c-f}$	0.18 $^{a-b}$
10	4.03 $^{d-c}$	1.73 $^{f-g}$	4.68 $^{d-e}$	2.54^{f-h}	3.81 $^{b-f}$	46.3 $^{b-c}$	0.21 $^{e-g}$	0.14 b-e
11	3.200 $^{e-h}$	2.44 $^{d-g}$	4.01 $^{d-c}$	2.84 $^{b-g}$	3.62 $^{d-f}$	65.5 $^{b-c}$	0.1 g-j	0.05 g-h
12	2.64 $^{e-h}$	1.78 $^{d-g}$	2.86 $^{f-g}$	2.6 $^{d-h}$	3.88 $^{g-f}$	65.5 $^{b-c}$	014 $^{e-j}$	0.10 c-h
13	3.00 $^{e-h}$	2.33 $^{d-g}$	3.56 $^{d-c}$	3.51 $^{a-e}$	3.84 $^{b-f}$	65.5 $^{b-c}$	0.13 $^{e-j}$	0.14 e-h
14	3.38 $^{e-h}$	1.79 $^{d-g}$	5.6 $^{a-c}$	3.52 $^{a-e}$	4.04 $^{b-f}$	71.1 $^{b-c}$	0.13 $^{e-j}$	0.12 c-h
15	3.57^{e-h}	2.26 $^{d-}$	5.11 $^{d-e}$	3.51 $^{a-c}$	3.58 $^{d-f}$	74.3 $^{b-c}$	0.1 g-j	0.09 $^{d-h}$
16	2.64 $^{e-h}$	1.73 $^{e-g}$	4.2 $^{d-e}$	3.31 $^{a-e}$	3.66 $^{d-f}$	71.1 $^{b-c}$	0.18 c-i	0.05 $^{f-h}$
17	3.61 $^{e-h}$	1.94 $^{d-g}$	4.65 $^{d-e}$	2.69 $^{b-c}$	3.91 $^{b-f}$	55.5 $^{b-c}$	0.12 $^{e-j}$	0.1 c-h
18	3.38 $^{e-h}$	2.42 $^{d-g}$	4.45 $^{d-e}$	3.03 $^{b-c}$	3.82 $^{b-f}$	64.4^{b-c}	0.1 $^{e-j}$	0.07 e-h
19	2.43 $^{e-h}$	1.6 $^{f-g}$	3.36 $^{f-g}$	2.20 $^{f-g}$	3.82 $^{b-f}$	77.7 $^{b-c}$	0.17 $^{c-g}$	0.12 $^{c-h}$
20	3.10 $^{e-h}$	1.37 ^{g}	4.34 $^{d-e}$	3.88 $^{a-e}$	3.77 $^{b-f}$	73.3 $^{b-c}$	0.17 $^{c-g}$	0.07 $^{e-h}$
21	4.40 $^{b-c}$	2.72 $^{c-f}$	4.16 $^{d-e}$	1.77 $^{f-a}$	3.76 $^{d-f}$	77.7 $^{b-c}$	0.16 $^{d-s}$	0.12 c-h
22	5.37 $^{a-b}$	4.4 ^{a}	5.33 $^{d-e}$	3.32 $^{a-e}$	4.79 $^{a-b}$	73.9 ^{b}	0.21 $^{c-f}$	0.15 b-e
23	3.81 $^{c-g}$	2.05 $^{d-g}$	5.36 $^{b-c}$	3.08 $^{a-e}$	4.14 $^{a-f}$	63.3 $^{b-c}$	0.16 $^{d-i}$	0.1 $^{c-h}$
24	2.53 $^{e-h}$	1.75 $^{f-g}$	3.76 $^{d-c}$	2.7 c-g	4.48 $^{a-c}$	78.8 ^{b}	0.08 ^{j}	0.05 g-h
25	5.33 $^{a-b}$	3.66 $^{a-c}$	4.97 $^{d-c}$	3.04 $^{a-e}$	4.4 $^{a-c}$	82.1 ^{b}	0.26 $^{a-b}$	0.13 $^{d-h}$
26	5.35 $^{a-b}$	3.89 $^{a-b}$	5.38 $^{b-c}$	3.06 $^{a-e}$	4.45 $^{a-c}$	72.7 $^{b-c}$	0.25 $^{b-d}$	0.19 a-c
27	2.184 $^{e-h}$	3.02 $^{b-c}$	3.20 $^{f-c}$	1.77 $^{f-g}$	3.76 $^{d-f}$	65.5 $^{b-c}$	0.1 $^{h-j}$	0.07 $^{e-h}$
28	2.87 $^{e-h}$	2.32 $^{d-g}$	3.48 $^{d-g}$	1.88 $^{f-g}$	4.3 $^{a-c}$	76.6 $^{b-c}$	0.15 $^{e-j}$	0.13 $^{c-g}$
29	2.48 $^{e-h}$	1.53 $^{f-g}$	4.26 $^{d-e}$	3.36 $^{a-e}$	4.28 $^{a-c}$	72.2 $^{b-c}$	0.14 $^{e-j}$	0.07 $^{e-h}$
30	4.1 c-f	1.73 $^{f-g}$	4.00 $^{d-g}$	2.33 $^{e-g}$	3.65 $^{d-f}$	70.0 $^{b-c}$	0.16 $^{d-i}$	0.09 $^{d-h}$
31	3.22 $^{e-h}$	1.82 $^{d-g}$	4.06 $^{d-g}$	1.88 $^{f-h}$	3.28 ^{e}	62.2 $^{b-c}$	00.12 $^{e-j}$	0.07 $^{e-h}$
32	3.44 $^{e-g}$	1.50 $^{f-g}$	4.8 $^{d-g}$	4.09 $^{a-b}$	3.53 $^{d-f}$	75.5 $^{b-c}$	00.11 $^{f-j}$	0.05 g-h
33	3.57 $^{e-h}$	1.65 $^{f-g}$	4.18 $^{d-g}$	2.75 $^{b-g}$	4.21 $^{a-e}$	75.5 $^{b-c}$	0.21 $^{c-f}$	0.14 $^{b-f}$

34	2.8 $^{e-h}$	1.81 $^{d-g}$	4.40 $^{d-g}$	2.38 f-g	4.14 $^{a-e}$	75.5 $^{b-c}$	0.21 $^{c-f}$	0.08 e-h
35	3.90 $^{c-f}$	1.76 $^{d-g}$	4.10 $^{d-e}$	2.74 $^{b-g}$	4.12 $^{a-e}$	76.6 $^{b-c}$	0.13 $^{e-g}$	0.07 e-h
36	4.41 $^{b-c}$	1.79 $^{d-g}$	5.03 $^{d-e}$	3.48 $^{a-e}$	3.34 ^{e}	78.7 $^{b-c}$	0.18 $^{c-h}$	0.14 $^{b-f}$
37	3.47 $^{e-h}$	2.07 $^{d-g}$	4.71 $^{d-e}$	2.31 $^{e-g}$	3.47 $^{e-f}$	92.8 ^{a}	0.17 $^{d--i}$	0.09 $^{d-f}$
38	5.17 $^{a-b}$	3.94 $^{a-b}$	7.21 ^{a}	4.32 ^{a}	4.5 $^{a-c}$	83.1 ^{b}	0.33 $^{a-b}$	0 0.22 $^{a-b}$
39	6.37^{a}	3.84 $^{a-b}$	7.06 $^{a-b}$	3.95 $^{a-c}$	5.07 ^{a}	89.4 ^{b}	0.4 ^{a}	0.26 ^{a}
40	2.82 $^{e-h}$	1.68 $^{f-g}$	3.67 $^{d-c}$	2.34 $^{f-h}$	3.51 $^{d-f}$	66.6 $^{b-c}$	0.11 $^{f-j}$	0.04 ^{h}

Means followed by similar letter are not significantly different at 5% probability level

Root length to shoot (R/S)

With the increasing intensity of drought stress during root to shoot ratio decreased, but this decrease was not statistically significant and the same genotype response to different levels of stress that goes against the findings [15]. High ratio of root to shoot is one of the most effective methods to adapt plants to drought. Root growth rate significantly higher than the growth of the stem, thus reducing transpiration and root water to get from the volume of soil that is indicative of a good indicator of drought tolerance. According to the response characteristics of the different osmotic potential seems to classification and screening genotypes for drought tolerance should use multiple-choice criteria and use an adjective in the presence or absence of drought tolerance should be avoided. Another report, Baalbaki *et al.* [10] found that drought stress reduced shoot dry weight, claw root dry weight compared to control, however, did not change.

Root dry weight

With increasing severity of drought stress from zero to 6 bar control of root dry weight decreased. Genotypes 38 and 5 with an average of 0.26 and 0.05 respectively the highest and lowest dry matter of root were hot. As noted by reducing the osmotic potential significant reduction in root dry weight was observed. Research conducted in the [13] was a function in addition to the total weight of root, root penetration depth depends. On the other hand, it has been reported that genotypes were significantly different in terms of root dry weight due to water absorption by the root in water potential is low. The genetic phenomena associated with plant resistance [15].

CONCLUSIONS

The results showed that the use of polyethylene glycol (6000) significant decrease germination percentage, germination, root and shoot dry weight and root dry weight ratio is wheat. The highest percentage of these traits in zero bar (control) and by decreasing water potential drought and increased levels of these traits were reduced. Notably, increasing length of roots in some wheat genotypes with increased stress on the importance of root length of wheat under drought conditions has been show.

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