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Study of Water Stress Effect on Wheat Genotypes on Germination Indexes

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Abstract: In order to study the effects of drought stress on germination indices in wheat cultivars, an experiment was conducted in factorial form, using a completely randomized design of four replications. In this experiment, ten wheat cultivars were evaluated in six levels of drought treatment (0, 3,-6,-9,-12,-15 bar).Results indicated significant differences among cultivars and drought stress levels. In all traits, a significant decrease was observed with increase in stress level. Drought stress reduces the radical length at more than -6 bars. Ardabil variety has the longest length of root with 72.6 mm. Seimareh had the longest length of plumule. The highest germination percentage belonged to 4057 (78%). The lowest germination percentage belonged to Maragheh with (49%). 4057, had the highest velocity of germination. .Traits in tolerant cultivars did not show a significant decline up to -3 bars. The most tolerant cultivar was 4057. Considering all germination indices, 4057 was the susceptible cultivar.

Key words: Germination index · Water stress · Wheat

INTRODUCTION

Drought is one the most important limiting factors of crop plants such as wheat in the world and Iran. This is of great importance especially in the arid and semi arid regions [1]. Over the one fourth of the earth includes dry areas and it has been cleared that nearly one third of the cultivated lands suffer from water deficit [1]. Current estimates indicate that 25% of the world's agricultural lands are now affected by water stress. It can be said that it is one of the most devastating environmental stresses. The high yield of a plant in sufficiently irrigated conditions is not necessarily related to high yield under drought stress and vice versa. Depending on which stage of growth a plant experiences drought stress, it reacts quite differently to the stress [2]. Insufficient required moisture for germination in the superficial layers of soil followed by drought stress in plants what Step One of the most important factors in a non-optimal deployment of what the plant is in dry regions. In such circumstances, can leave more buds of deep soil with drought tolerance in crop growth stage what the important features associated with plant what is optimal deployment. In dry areas, farmers will try to kill seeds in the soil moisture environment for the emergence of seed well is enough. In such circumstances to ensure that the plant is more established, planting depth between 8 to 12 cm is considered. However, the optimal moisture conditions suitable planting depth of about 2 to 4 centimeters is [3]. Germination is a critical stage of the plant life and resistance against drought during the germination makes a plant stable. Iran, with an annual 240 mm of rainfall, is classified as a dry region of the world. One of the commonest experiments in germination of the seeds is the application of PEG. Many experiments have been done and the results have showed that plumule is more likely to be affected by water stress than other traits. De and Kar [4] investigated the effect of different osmotic stresses (from 0 to -8× 105 Pa obtained with NaCl or polyethylene glycol 6000 solutions o the germination of flax sesame and onion seeds. The rate o seed germination and the final germination percentages a well as the amount of water absorbed by the seeds were considerably lowered with the rise of osmotic stress level whatever the stress agent used, more considerable reduction was obtained under polyethylene glycol 6000 than under NaCl. Emmerichand and hardegree[5] reduced germination under high osmotic potential (more negative) to causing potential of toxic compounds and osmotic and sepanlu and siadat[6] to reduce surface contact with the seeds and lower water hydraulic water around seeds consider relevant [7]. Degree of sensitivity associated with different

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physiological characteristics and speed of germination to different osmotic potentials showed that the germination rate of more than germination was sensitive to water stress in high osmotic potential greater intensity than germination is reduced. This study was performed for effect of drought stress on the germination of wheat genotypes.

MATERIALS AND METHODS

This study was performed in 2010 in laboratory condition in Ardabil. In order to study the effects of water stress on germination indices in wheat genotypes, an experiment was conducted in factorial form, using a completely randomized design with four replications. In this experiment, ten wheat genotypes (table 1 as first factor) with six levels of drought treatment (second factor: distilled water, -3,-6,-9,-12,-15 bar) of PEG 6000 was performed.

PEG 6000 was prepared by dissolving the required amount of PEG in distilled water (at 25°C). The seeds were surface sterilized with 0.01% $HgCl_2$ solution for one minute. After the treatment the seeds were washed several times with distilled water. 25 seeds were put in each Petridis on filter paper moistened with respective treatment in 4 replications. The Petri dishes were covered to prevent the loss of moisture by evaporation. The Petri dishes were put into an incubator for 8 days at 20 degrees centigrade. Every 24 hours after soaking, germination percentage and other traits were recorded daily. Seeds were considered germinated when the emergent radical reached 2 mm length. Rate of germination, coefficient of velocity of germination and Germination index (GI) were calculated using the following formulas:

Table 1: list of genotypes

NO.	Name	NO.	Name
1	Sarab	6	Ardabil
2	Sanandaj	7	Seimareh
3	sabalan	8	Maragheh
4	11010	9	Tabriz
5	Ahar	10	4057

Table 2: Value of PEG for stress levels

NO.	PEG (gr/lit)	Stress level (bar)
1	138	-3
2	189	-6
3	222	-9
4	251	-12
5	270	-15

Rate of germination = $\delta A/\delta Tt$

Coefficient of velocity of germination:

$$\frac{A_1 + A_2 + ... + A_*}{A_1T_1 + A_2T_2 + ... + A_*T_*} \times 100$$

(Pollock and Ross 1972)

Mean of day germination = $\Sigma\ (Nt\ /\Sigma N)$

Germination index (GI) was calculated by the following formula:

$$GI = \frac{\text{Total number of seed germinated}}{\text{Total number of seed observed}} \times 100$$

Every day the number of seeds germinated (2 mm radical) recorded for 10 days continued at the eleventh day as root and coleoptiles measurements and fresh weight of root and coleoptiles measurement and into the oven at temperatures 75° C for 24 hour were placed after the mentioned period of dry samples was measured and recorded.

RESULTS

The result of analysis variance showed significant difference among studied traits, condition and genotypes. Witch represents the genetic richness in genotypes.
Increasing drought levels had deleterious effect on germination (Table 3).

Germination Index: There are significant differences among varieties and drought levels. The highest germination index belonged to Maragheh genotype and the shortest germination index belonged to Tabriz (Fig. 1).

Stress Germination Index: The highest germination index belonged to Ardabil genotype and the shortest germination index belonged to 11010 (Fig. 2).

Radical Length: The tallest radical belonged to 11010 with 73.7 mm and the shortest radical belonged to Ahar with 19.8 mm. The results showed that with the increasing of drought stress level, radical length decreased (Fig. 3).

Length of Plumule: The highest plumules belonged to seimareh and the shortest plumules belonged to Ahar with 8.9 mm (Fig. 4). In general, plumule length is strongly affected by droughts stress levels, especially levels upper than -6. Jajarmi in his studies of salinity effects on safflower has come to similar results [4].

Table 3: Mean Comparison of traits

NO.	Genotypes	Average Velocity of germination	Index Average Velocity of germination	Mean of Day germination	Germinati on Percent	Plumule length (mm)	Radical length (mm)	Stress germination index	Germination index
1	Seimareh	4.9b	15.8b	6.7b	77b	17.8a	41.8cb	9896b	10232.35b
2	sabalan	4.4cb	15.4b	5.4c	72cb	16.6a	44.6cb	9756b	11065.65a
3	Ahar	4.3c	12.3d	6.5b	71c	8.9d	19.8d	11254a	10986.6b
4	Ardabil	3.6ab	13.4cd	6.2b	76b	12.6c	45.7cb	12653a	9054.2c
5	Sarab	5.0b	15.4b	8.4a	79b	14.5b	39.9c	8956c	11387.25a
6	Maragheh	3.9c	14.9cb	7.6ab	60d	14.7b	36.9c	9568b	12013.25a
7	Tabriz	4.6ab	16.2a	6.5b	76b	15.2b	41.6cb	10256ab	9054.65c
8	Sanandaj	4.5cb	14.3c	6.6b	77b	14.3b	45.2cb	11032a	11458.56a
9	4057	5.2a	16.7a	7.2ab	89a	16.5a	32.3c	11254a	9865.2c
10	11010	3.8d	14.5c	7.7ab	66d	12.3c	73.7a	8957c	11328.25a

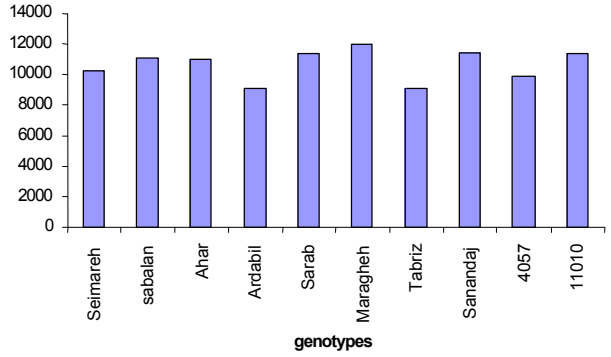

Fig. 1: Mean Comparison of germination index

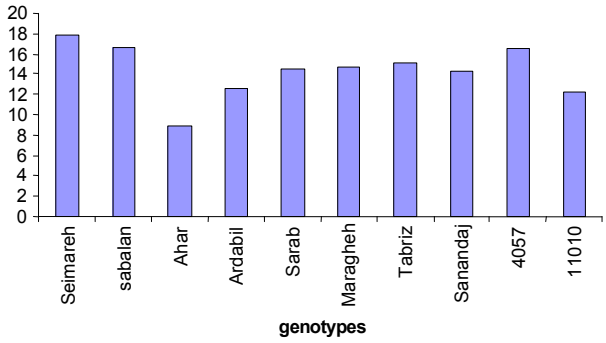

Fig. 4: Mean Comparison of Length of Plumule

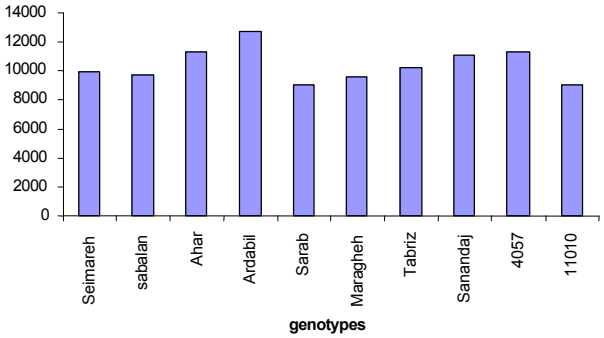

Fig. 2: Mean Comparison of Stress germination index

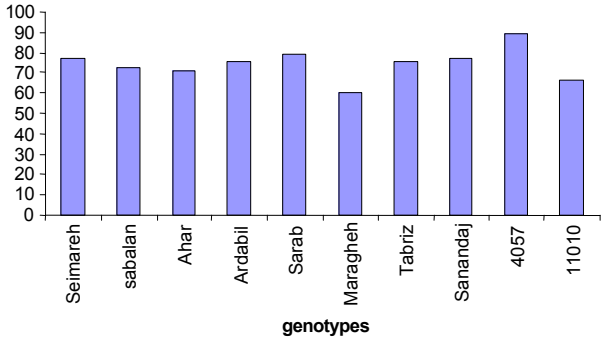

Fig. 5: Mean Comparison of Germination percentage

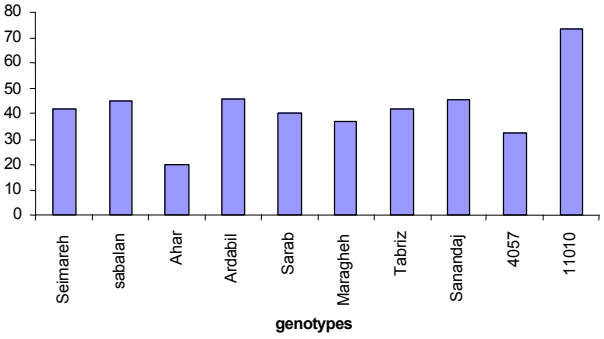

Fig. 3: Mean Comparison of Radical length

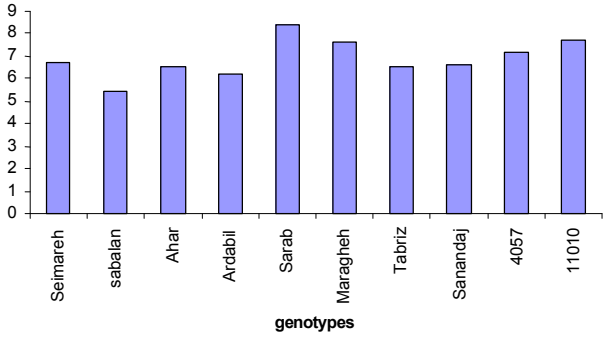

Fig. 6: Mean Comparison of Mean of day Germination

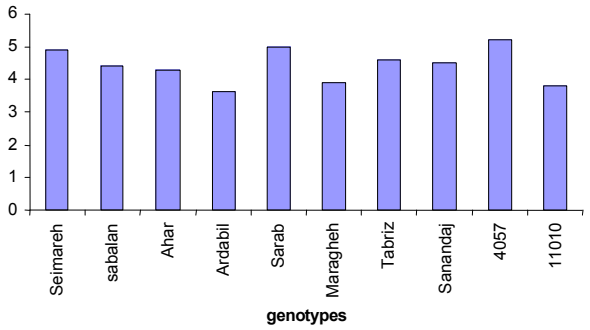

Fig. 7: Mean Comparison of Mean of Average Velocity of Germination

Germination Percentage: The highest germination percentage was observed in -3 level, indicating its high tolerance to drought stress and the least belonged to -15 bar with 29%. Maragheh has the lowest germination percentage (Table 3). Among varieties the highest percentage belonged to 4057 (Fig. 5).

Mean of Day Germination: The highest mean of day germination belonged to Sarab with 7.3 days. It showed that average velocity of germination in this variety is very slow, although sabalan variety had the least with 4.3 days, indicating its high germination velocity. The shortest mean day germination was observed under - 6 level, belonging 4057 These varieties had both the highest germination percentage and velocity of germination, resulted from their high genetic potentials (Fig. 6).

Average Velocity of Germination: T he highest (AVG) belonged to 4057 and the least belonged to 11010 (Fig. 7).

DISCUSSION

In the study the tolerance of varieties to drought stress, germination percentage cannot be a good index in screening varieties, This is because of the germination percentage trait was affected by drought stress less than the other traits as well it is strongly influenced by the environment in which the seed developed, seed age and storage conditions. To find the best tolerant variety to such conditions, taking all traits into account in this study, we found that 4057 variety is the most resistant and 11010 is the most sensitive varieties.

REFERENCES

1. Kirigwi, F.M., M. Van R. Ginkel, G. Trethowan, R.G. Sears, S. Rajaram and G. M. Paulsen, 2004. Evaluation of selection strategies for wheat adaptation across water regimes. Euphytica, 135: 361-371.
2. Jajarmi, V., 2007. Effects of Water Stress on Germination Indices in ten Rapeseed Cultivars (*Brassica napus* L.). Abstracts the second seminar of agriculture and environment. Islamic Azad University - Khoy branch- Iran.
3. Paulsen, G.M., 1987. Wheat stand establishment. PP. 387-389. In: E.G. Heyne (Ed.), Wheat and Wheat Improrant. 2nd edition, Am Soc. Exp. Agron. USA.
4. De, R. and R.K. Kar, 1995. Seed germination and seedling growth of mungbeen (*Vigna radiata*) under water stressinduced by PEG 6000. Seed Sci. Technol., 23: 301-308.
5. Emmerich, W.E. and S.P. Hardegree, 1991. Seed germination in polyethylene glycol solution: effect of filter paperexclusion and water vapor loss. Crop Sci., 31: 454-458.
6. Sepanloo, M.G.H. and H. Syadat, 1999. Effect of water stress on germination characteristics of wheat. Soil Water. Sci., 13: 87-97.
7. Abdul- baki, A.A. and J.D. Anderson, 1970. Viability and leaching of sugars from germinating barley. Crop Sci., 10: 31-34.