Effect of Biological Fertilizers on Germination Indices in Wheat Cultivars With Drought In Greenhouse

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Abstract: To determine aminol-forte and fosnutren, as two biological fertilizers containing amino acids, effects on 11 bread wheat cultivars in Ardabil IAU research greenhouse a research was carried out in factorial completely randomized block design with three replications. Factor A in two conditions (drought and normal), factor B in three levels (water, aminol-forte and fosnutren) and factor C included 11 bread wheat cultivars. Results suggested that there was a significant difference between test conditions based on all measured indices at 1%. Also there was a significant difference between studied cultivars based on assessed properties at 1 to 5%. There was a significant difference between fertilizer levels based on germination speed coefficient, ultimate germination percentage, germination rate index and daily average germination rate at 5%. The test conditions interaction in biologic fertilizers in all studied traits were significant at 1%. The results to the means comparison suggested that genotypes of Kuhdasht with a mean of 57.57, Saisons with a mean of 57.13, Azar 2 with a mean of 56.64 and Zagros with a mean of 56.60 had the highest germination duration mean and Chamran genotype with a mean of 46.39 had the lowest germination duration mean. On germination rate, also, Chamran genotype with a mean of 0.0218 had the best and Kuhdasht and Saisons genotypes with means of 0.0173 and 0.0175, respectively, had the lowest germination rate. Results to the data mean comparisons on fertilizer levels indicated that fosnutren liquid fertilizer was the best genotype in germination rate coefficient, germination duration mean and germination rate index. Finally, it could be mentioned that applying biological fertilizers which contain amino acids, could play a great positive role in wheat germination indices.

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Introduction

Considering the population growth in Iran and the world, and also lack of food in the world, studying all strategies which could increase the production and wheat optimal use, have been taken into considerations. Among the main factors which play roles in wheat is the seeds quality or seed masses that are among the most significant crop production inputs and have great importance in desirable yield (Qorbani et al, 2005). Indecent quality, inadequate germination and deployment are among the main difficulties which crops confront in various regions. The quality is affected by various factors such as cultivar, genetic purity, physical purity, viability, germination capability, and seed viability. Other factors such as genetic structure, environment, and maternal nutrition, maturity stages during harvesting time, mechanical damages, seed reserves, age, wear and pathogen could affect germination and seed yield. Germination is the first stage in wheat growth which is of a great significance. Along with germination, germination rate and consistency and also seed vigor are among important parameters in seed quality (Soltani et al, 1996). Seed's vigor and quality are affected by the seed age and wear and consequently it decreases the germination capacity and rate (Macdonald et al., 2004; Basra et al., 2003; Defigueiredo et al., 2003). Seeds with higher quality and vigor could grow better and they have higher germination rate and growth percentage in confronting environmental stresses and finally, they provide stronger seedlings (Salehiyan, 1995). According to the various observations in studying various seed masses in various plant species in laboratory and field conditions, it has been proven that the germination percentage of a seed mass in the laboratory is different from the seedling deployment in the field. These differences and changes are due to the differences in various seeds masses vigor (Rouzrokh and Qasemi Gol'azani, 1998). Environmental stresses, especially drought stress plays an important role in reducing plant growth, especially during germination in arid and semiarid regions of Iran. Drought stress occurs when the amount of water intake plant is less than its losses. In addition to restricting water uptake of seed by affecting fluidity reserves and fetal protein synthesis, drought and salinity stresses can cause decreased germination (Jevad, 2002). Osmotic and ionic compounds created by the stresses can be effective on these parameters, although, the impact depends on the type of material that causes stress and type of cultivar (Jevad, 2002; Ikeda et al., 2002). Identifying cultivars or genotypes which are more tolerant to the stresses in germination stage is of essence (Pessarkli et al, 1991). Considering the biologic fertilizers positive effects on various growth stages, studying various fertilizer types for finding proper method in retrofitting against drought stress during germination is of a huge significance (Shahryari and Khayatnejad, 2011). Thomas et al (2009) studied the effect of amino acids formulations such as humiforte which are biologically active, on tea quality and production. Also, Mostafa et al (2010) studied arginine's effect on growth and yield in late-planting wheat. Some biological stimuli, such as humiforte to create environmental stresses, have been released in the market. The objective to this research is to study the response of various wheat cultivars to two amino acid types on germination and identifying wheat cultivars which are proper for optimal fertilizer and water resources.

Material and methods

To study the aminol-forte and fosnutren effects, as two biological fertilizers containing amino acids, on 11 bread wheat cultivars a research was conducted in Ardabil IAU research greenhouse. The research was carried out in factorial completely randomized block design with three replications. Factor A in two conditions (drought and normal) and factor B in three levels (water, aminol-forte and fosnutren) and factor C included 11 bread wheat cultivars (Table 1).

Table1. Genotypes name that used in this study

NO.	Name	NO.	Name
1	Rasad	7	Saisons
2	Kuhdasht	8	Sardari
3	Gascogne	9	Azar2
4	Bezostaya	10	Zagros
5	Cross Sabalan	11	chamran
6	MV-17	-	-

The amount of Aminol-forte and fosnutren used in this compound was 2 ml per 500 ml water. Polyethylene glycol 6000 was used as the drought agent in greenhouse condition for drought treatment. After providing equal amount of sand, gravel and slit for each pot, 10 seeds were planted in each pot. Pots were watered with water and solutions according to the planting map. The drought stress treatment was conducted on the plant by polyethylene glycol solution after three days. To measure the germination indices, germinated seeds were counted daily. Coefficient velocity germination (CVG), germination rate index (GRI), mean germination time (MGT), final germination percentage (FGP), germination rate (Rs) and mean daily germination (MDG) were calculated by the following formulas (Table 2):

Table 2 - The formula used to calculate the index of germination

Germination indices	The Formula used
Coefficient Velocity Germination (CVG)	$\sum NiTi / \sum Ni \times 100$ CVG (Scott et al, 1984) =
germination rate index (GRI)	$X / Gx + \ldots + G2 / 2 + G1 / 1 =$ GRI (Ruan et al, 2002)
final germination percent (FGP)	$100 \times Ng / Nt =$ FGP(Ruan et al, 2002)
mean germination time (MGT)	$\sum Ni = 100 / CVG / \sum NiTi =$ MGT(Kulkami et al, 2007)
germination rate (RS)	$1 / MTG =$ Rs (Rajabi and Poostini, 2004)
mean daily germination (MDG)	$FGP/d =$ MDG (Scott et al, 1984)

Data variance analysis and comparing their means were carried out by MSTATC and SAS softwares. Means were compared by using Duncan's multiple-range test at 5%.

Results

Considering the variance analysis results on studied traits (Table 3), it was observed that there was a significant difference between research conditions in all measured indices at one percent. There was also a significant difference found between studied cultivars on coefficient of velocity of germination (CVG), mean germination time

(MGT), germination rate (Rs) and germination rate index (GRI) at one percent. There was a significant difference found between studied cultivars on final germination percentage (FGP) and mean daily germination (MDG) at five percent. This suggests the genetic variation between cultivars for selecting desired traits. The fertilizer levels showed a significant difference on coefficient of velocity of germination (CVG), germination rate index (GRI) and mean daily germination (MDG) at 5%. The interactive effect of research conditions and biological fertilizers combination was significant on all studied traits at 1%. There was no significant difference found between other interactive effects on any of studied traits. Results to the data mean comparison (Table 4) on studied cultivars suggested that genotypes of Kuhdasht with a mean of 57.58, Saisons with a mean of 57.13, Azar 2 with a mean of 56.64 and Zagros with a mean of 56.50 had the highest mean germination time (MGT). Chamran genotype with a mean of 46.39 had the lowest mean germination time (MGT). On germination rate (Rs), Chamran genotype with a mean of 0.0218 was the best and genotypes of Kuhdasht and Saisons with means of 0.0173 and 0.0175 had the lowest germination rates (Rs). Sardari genotype formed one group, Gascogne formed another group, Rasad and Bezostaya and Cross Sabalan genotypes in formed group, and also MV17, Azar 2 and Zagros formed another group and showed no differences in other traits. Kuhdasht and Zagros cultivars with a mean of 100 percent had the height final germination percentage (FGP), while Sardari genotype with a mean of 93.33 percent had the lowest final germination percentage (FGP). Cross Sabalan, Saisons and Azar 2 formed on group and Rasad, Gascogne, Bezostaya and MV 17 formed another and Chamran formed another group and they showed no differences in other traits. On germination rate index (GRI) in studied cultivars, Saisons genotype with a mean of 9.82, Kuhdasht with a mean of 9.79 and Azar 2 with a mean of 9.79 were the best cultivars while Chamran with a mean of 6.85 had the lowest germination rate index (GRI). Zagros and Kuhdasht cultivars with a mean of 7.69 had the highest mean daily germination (MDG) while Sardari with a mean of 7.17 had the lowest mean daily germination (MDG). Based on coefficient of velocity of germination (CVG) among the studied cultivars, Azar 2 with a mean of 10.91 and Saisons with a mean of 10.88 were the best cultivars while Chamran with a mean of 10.17 had the lowest coefficient of velocity of germination (CVG). Results to the data mean comparison (Table 5) on fertilizer levels indicated that liquid fosnutren fertilizers was the best based on coefficient of velocity of germination (CVG), mean germination time (MGT) and germination rate index (GRI) and aminol-forte liquid fertilizer along with fosnutren was the best on final germination percentage (FGP) and mean daily germination (MDG). Based on germination rate (Rs), normal water conditions with a mean of 0.020 was the highest while fosnutren liquid fertilizer with a mean of 0.017 had the lowest germination rate (Rs).

Discussion

Shahryari and Khayatnejad (2011) conducted a research to assess the humiforte spraying effect on two wheat cultivars in late season drought stress and calculated some tress-tolerant traits and indices. They came to this conclusion that humiforte in both with stress and without stress conditions, has significantly affected the yield. Calculating the stress-tolerant indices in their research suggested that humiforte increases the wheat cultivars tolerance against late season drought.

Alaei et al (2012) conducted a research to study the effect of two types of biological fertilizer containing amino acids on germination indices of wheat varieties under in vitro drought stress condition. They concluded that fosnutren biological fertilizer has been able to put a more positive effect on the studied indices.

Table 3 - Analysis of variance was assessed in different experimental conditions for different wheat cultivars

Source of Variations	df	Mean Square Coefficient Velocity Germination	mean germination time	germination rate	final germination percent	germination rate index	mean daily germination
Condition	1	6.828 **	4450.291 **	1.059×10^{-3} **	6222.727 **	225.173 **	36.860 **
Fertilizer levels	2	0.354 *	70.154 ns	1.611×10^{-5} ns	192.424 *	5.993 *	1.137 *
Genotype	10	1.052 **	169.772 **	4.620×10^{-5} **	98.181 *	12.535 **	0.581 *
C×F	2	1.349 **	948.466 **	2.223×10^{-4} **	1246.969 **	47.462 **	7.385 **
C×G	10	0.123 ns	54.305 ns	1.984×10^{-5} ns	52.727 ns	2.743 ns	0.311 ns
G×F	20	0.077 ns	33.159 ns	1.019×10^{-5} ns	59.090 ns	1.735 ns	0.349 ns
C×F×G	20	0.139 ns	25.377 ns	6.99×10^{-6} ns	20.303 ns	2.003 ns	0.119 ns
Error	132	0.149	41.184	1.518×10^{-5}	51.010	2.281	0.301
CV (%)	-	3.68	13.12	18.28	7.76	19.28	7.76

* and ** Significantly at $p < 0.05$ and < 0.01, respectively

Table 4 - Comparison of studied traits for wheat

Genotypes	Characters Coefficient Velocity Germination	mean germination time	germination rate	final germination percent	germination rate index	mean daily germination
Rasad	10.83 ab	52.45 abc	0.0195 bcd	95.55 abc	8.95 abc	7.34 abc
Kuhdasht	10.84 ab	57.58 a	0.173 d	100.00 a	9.79 a	7.69 a
Gascogne	10.36 cd	50.92 bcd	0.0200 abc	97.77 abc	7.90 cd	7.51 abc
Bezostaya	10.74 ab	53.81 abc	0.0186 bcd	97.77 abc	8.98 abc	7.51 abc
Cross Sabalan	10.51 bc	52.60 abc	0.0192 bcd	98.88 ab	8.38 abc	7.60 ab
MV 17	10.82 ab	55.79 ab	0.0182 cd	97.77 abc	9.49 ab	7.51 abc
Saisons	10.88 a	57.13 a	0.0175 d	98.88 ab	9.82 a	7.60 ab
Sardari	10.66 abc	50.14 cd	0.0205 ab	93.33 c	8.32 bc	7.17 c
Azar 2	10.91 a	56.64 a	0.0178 cd	98.88 ab	9.79 a	7.60 ab
Zagros	10.81 ab	56.50 a	0.0180 cd	100/00 a	9.58 ab	7.69 a
Chamran	10.17 d	46.39 d	0.0218 a	94.44 bc	6.85 d	7.26 bc

Differences between averages of each column which have common characters are not significant at probability level of 5%.

Table 5 - Comparison of traits for the different experimental conditions

Experimental conditions	Characters Coefficient Velocity Germination	mean germination time	germination rate	final germination percent	germination rate index	mean daily germination
Water	10.50 b	49.65 c	0.020 a	94.54 b	7.90 c	7.27 b
Aminol Forte	10.66 b	53.73 b	0.018 b	98.78 a	8.84 b	7.59 a
Fosnutren	10.90 a	57.51 a	0.017 c	99.39 a	9.95 a	7.64 a

Differences between averages of each column which have common characters are not significant at probability level of 5%.

Conclusion

Results to this research indicated that Kuhdasht cultivar was the best in several traits and also, using fosnutren liquid fertilizer had the highest effect on wheat germination indices, comparing to the other amino acid fertilizer. Finally, it could be said that using biological fertilizers, such as fosnutren which contains free amino acids and oligopeptide, along with other biological fertilizers and in various conditions and percentages, could have a great positive role on wheat germination indices.

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