141

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ORIGINAL ARTICLE

Humiforte Application for Production of Wheat under End Seasonal Drought Stress

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ABSTRACT

Wheat is the most common crop in the world and Iran. Mediterranean areas such as our region (Ardabil) are subjected to terminal drought. Some of bio stimulants e.g. Humiforte introduced for market as shock treatments. An experiment were done for evaluation effect of spraying by Humiforte on two wheat genotypes (Sabalan and 4057) facing terminal drought stress. Some of yield related traits measured and stress tolerance indices were calculated. Statistical results revealed that Humiforte had increasingly effect on yield in the both stressed and non stressed conditions. It increased tolerance of under study wheat genotypes to terminal drought stress pay attention to tolerance indices. Humiforte is recommendable for production of wheat in Ardabil region, especially, in the condition of terminal drought condition.

Key words: *Triticum aestivum*, Bio stimulate, Amino acid, Stress

Introduction

Wheat (*Triticum aestivum* L.) is the core commodity of the Iranian food and agriculture systems, grown on nearly half of the country's rain-fed areas and one-third of the irrigated area. As such, the rain-fed wheat crop covers nearly 4.5 million hectares, while the irrigated wheat crop covers approximately 2.2 million hectares. The average yield for irrigated wheat is approximately 3.0 ton/ha, compare to 0.95 ton/ha for rain-fed wheat. Most of the rain-fed wheat crop is located in the western provinces of Kermanshah, Kurdistan, and Azerbaijan, with a larger share of the irrigated wheat crops located in the east [2]. One of the major problems in agriculture is abiotic stress which prevents plants from realizing their full genetic potential and limits food production. In arid and semiarid regions with Mediterranean climate, wheat crops usually encounter drought during the grain filling period, which reduces grain yield, dramatically [3]. Yield is reduced mostly when drought stress occurs during the heading or flowering and soft dough stages [12]. Wheat production is subjected to water deficit after anthesis in Ardabil region, Iran [12].

According to the 3-D plot classification of Fernandez [4], the group A genotypes have high yield in both non-stressed and stressed environments, genotypes in group B favored a non-stressed environment, group C genotypes favored stressed environments and the group D genotypes have low yield in both stressed and non-stressed environments. Biofertilizers may be classified as: Carrier based inoculants fixing atmospheric nitrogen or by stimulating plant growth through synthesis of growth promoting substances; blue green algae or Cynobacteria mycorrhizae [1]. Biofertilizers can add 20-200 kg N ha^{-1} (by fixation), liberate growth-promoting substances and increase crop yield by 10-50%. They are cheaper, pollution free, based on renewable energy sources and also improve soil tilth [8]. Amino acids as organic nitrogenous compounds stimulated cell growth acting as buffers maintaining favorable pH value within the plant cell as well as

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synthesizing other organic compounds, such as protein, amines, purines and pyrimidines, alkaloids, vitamins, enzymes, terpenoids and others [6].

Slavik [14] applied humiforte to stimulate shoot growth of Norway spruce. Humiforte is a high-tech soluble liquid nutrient, with rapidly absorption via leaves or roots, and a high concentration of free amino acids and biologically active oligopeptides, especially recommended for shock treatments.

Thomas *et al.* [15] studied role of biologically active amino acid formulations such as Humiforte on quality and productivity of tea crop. Mostafa *et al.* [7] studied effect of Arginine on growth and yield of late sowing wheat. The present research was aimed to document the influence of foliar applied active formulation of Humiforte on yield and its component of wheat under terminal drought of Ardabil region.

Materials and methods

An experiment was conducted for evaluation response of two winter bread wheat (Triticum aestivum. L) genotypes namely Sabalan and 4057(prepared from Agriculture and Natural Recourses Reseach Centre of Ardabil) to a bioactive preparation Humiforte (Table 1) under terminal drought stress in Ardabil region, Iran. This is made by INAGROPARS Company in Iran that is collaborated with INAGROSA Company in Spain.

This research was placed in Agriculture Research Farm of Islamic Azad University, Ardabil branch. The results of soil test were presented in Table 2. Size of plots was 100× 120 cm². Six rows were planted by distances of 20 cm per plot, and the length of rows was 1 meter.

Experimental design was factorial on the basis of completely randomized block design with three replications. Three factors were irrigation levels (well watered; terminal drought), genotypes, Humiforte (with Humiforte; without Humiforte). Spraying with Humiforte applied at the tillering, stem elongation and grain filling period to amount of 2.5 mL L^{-1}. Five times irrigation were given to the well watered treatments, and two times no irrigation were given to the drought treatments after anthesis.

All the cultural practices were uniformly applied to all the experimental units. After physiological ripening, plant samples were taken at random. These characters were measured: plant height, spike length, spike weight, kernels per ear and grain weight. Grain weight per plot was considered as grain yield.

Data were analyzed using SPSS16 for analysis of variance and Duncan's multiple range tests was apply for the mean comparisons. Follow tolerance to stress indices used for determination drought tolerance of under study wheat genotypes at presence of Humiforte [4]:

1. Stress Susceptibility Index (SSI): SSI= (1-(Ysi/Ypi))/SI; SI= 1- (Ys/Yp)
2. Stress Tolerance Index (STI): STI= (Ypi×Ysi)/Yp2 MSTI= KSTI
3. MSTI = K_1(STI) ; $K_1=Y_{pi}^2/Y_p$
4. Tolerance Index (TOL): TOL=Ypi-Ysi
5. Geometric Mean Productivity (GMP): GMP= √Ypi×Ysi
6. Mean Productivity (MP): MP= (Ypi+Ysi)/2

Where Ysi is stress yield, and YPi is optimal (potential) yield of a given genotype. Ys and Yp are average yield of all genotypes under stress and optimal conditions, respectively.

Table 1: Analysis of soil tests.

	Soil texture Sand	Slit	Clay	Absorbent potassium (ppm)	Absorbent Phosphorus (ppm)	Total nitrogen (percent)	Organic carbon (percent)	Neautral reacting material (percent)	Total acidity (pH)	Electrical conductivity (ds / m)	Saturation	Depth (cm)
Clay loam	31	41	28	460	4.8	0.103	0.97	4.8	7.8	2.66	48	0-30
Clay	40	36	24	290	2	0.056	0.47	7	8.2	2.4	45	30-60

Table 2: Aminogram distribution and supplementary compound of Humiforte

Compounds	Supplementary	Distribution (%)	Amino gram	Distribution (%)	Amino gram
Glycine	1.8	Phenilalanine	5.1	Total nitrogen (N)	6.00 % w/w
Valine	5.1	Methionine	4.2	Ammoniac nitrogen	1.40 % w/w
Proline	8.4	Serine	3.9	Uric nitrogen	3.70 % w/w
Alanine	13.21	Threonine	3	Nitric nitrogen	0.50 % w/w
Aspartic acid	4.5	Histidine	3	Organic nitrogen	0.30 % w/w
Arginine	8.4	Glycocoll	9.6	Organic matter	2.00 % w/w
Glutamic acid	0.9	Tyrosine	1.5	P2O5 (soluble in water)	3.00 % w/w
Lysine	5.1	Glutamine	0.9	K2O (soluble in water)	5.00 % w/w
Leucine	16.51	Cystine	0.3	Free amino acids	3750 mg/l
Isoleucine	4.5	other	0.08		

Results:

Results of ANOVA (Table 3) showed that irrigation levels had significant differences for plant height, seed number per spike, seed weight per spike, harvest index and yield for conditions. These traits affected by terminal drought, but it had not effect on spike length, spike weight and 1000 seed weight.

Genotypes had different responses for measured traits except of spike weight, seed weight per spike and 1000 seed weight (Table 3). Interaction of Irrigation levels× Genotypes were significant for spike length, seed weight per spike, harvest index and yield.

Humiforte factor showed differences for spike length, seed number per spike, harvest index and yield. There were significant differences in spike length, seed weight per spike, 1000 seed weight and harvest index. Interaction of Humiforte× Genotype was significant for spike length, seed weight per spike and harvest index. There were not significant differences between measured traits for Humiforte× Irrigation levels× Genotype. Humiforte increased grain yield from 336 kg/plot to 472 kg/plot in well watered, and from 149 kg/plot to 285 kg/plot in drought condition (Tables 4 and 5). Increasing of yield in well watered condition was about 41%, and it was 91% for stress condition.

Table 3: Results of Analysis of variance for studied traits

		MS							
S.O.V	df	Spike length	Plant height	Spike weight	Seeds number per spike	Seed weight per spike	1000 seed weight	Harvest index	yield
Rep	2	0.108ns	280.62**	0.55ns	56.85ns	0.068ns	3.4ns	271.52ns	2992.87ns
Irrigation levels	1	1.40ns	472.86**	0.78ns	139.82*	0.90**	0.51ns	13448.50**	209132.0**
Genotype	1	19.22**	1168.59**	0.069ns	224.91**	0.27ns	4.16ns	14459.63**	77063.2**
I× G	1	4.62**	16.08ns	0.092ns	57.44ns	0.006**	0.118ns	3100.14**	23622.2**
Humiforte	1	8.61**	21.56ns	0.12ns	184.09*	0.17ns	5.45ns	3246.86**	110884.8**
H× I	1	7.12**	12.92ns	0.10ns	46.67ns	0.34*	9.72*	633.07*	2.60ns
H× G	1	7.48**	6.41ns	0.16ns	0.44ns	0.32*	2.99ns	1265.02**	5350.01ns
H× I× G	1	0.25ns	8.27ns	0.001ns	8.48ns	0.01ns	0.61ns	5.59ns	1611.95ns
Error	14	0.66	32.92	0.25	31.76	0.095	2.6	138.97	1791.97

ns: non significant differences; *: significant at p<0.06; **: significant at p<0.01

Table 4: Drought stress indices of genotypes without Humiforte.

Genotype	Yp	Ys	SSI	TOL	MP	STI	GMP	MSTI
Sabalan	254.23	147.33	0.96	165.9	363.9	0.35	198.29	0.33
4057	416.84	151.66	1.92	222.06	449.57	0.5	238.08	0.24

Table 5: Drought stress indices of genotypes with Humiforte.

genotype	Yp	Ys	SSI	TOL	MP	STI	GMP	MSTI
Sabalan	377.36	236.36	0.79	141	445.54	0.4	264.28	0.39
4057	566.91	333.20	0.74	233.71	629.23	0.79	369.73	1.56

Discussion:

Thomas *et al.* [15] found that Humiforte increased the yield of tea crop to about 37%. In present study, total wheat's yield was 243 kg/plot without application of Humiforte, however, spraying with Humiforte increased it to 379 kg/plot. Therefore increasing of wheat yield was about 56%. 4057 had the high yield compared with Sabalan in the both condition of well watered and drought conditions without use of Humiforte. Also, it had high yield than Sabalan by application of Humiforte in the both irrigation levels. Robertson and Giunta [10] reported that generally superior genotypes in terms of water stress desirable have higher grain yield in stress conditions also. Increasing of yield by role of Humiforte was noticed about 60% for Sabalan and 120% for 4057 in stressed condition; and 48% for Sabalan and 36% for 4056 in well watered condition.

Rosielle and Hamblin [11] defined stress tolerance (TOL) as the differences in yield between the stressed (Y_s) and non-stressed (Y_p) environments and mean productivity (MP) as the average yield of Y_s and Y_p. Fischer and Maurer [5] proposed a stress susceptibility index (SSI) of the cultivar. Fernandez [4] defined a new advanced index (STI= stress tolerance index) which can be used to identify genotypes that produce high yield under both stressed and non-stressed conditions and claimed that selection based on STI and GMP would result in genotypes with higher stress tolerance and good yield potential. The geometric mean (GM) is often used by breeders interested in relative performance since drought stress can vary in severity in field environment over years [9].

Comparison of stress tolerance indices means revealed that Humiforte could decrease amounts of MSTI, GMP, STI and MP respectively by 0.69, 98.82, 0.17 and 130.65, but increased TOL and SSI respectively by 6.62 and 0.67. Stress intensity was 56% (SI= 0.56) when did not used Humiforte, but application of that caused to decrease in stress intensity to 40% (SI= 0.40). This means that Humiforte successfully decreased 16% stress intensity.

SSI means of two genotypes decreased from 1.44 to 0.77. It translates to noticeable effect of Humiforte for decreasing of this index and increasing of tolerance to terminal drought. It is not possible select 4057 as a tolerant genotype in the condition of without Humiforte application. Because it's SSI was higher than one. But Humiforte could decrease this numerical value from 1.92 to 0.74. Thus 4057 was tolerant similar to Sabalan in the condition of Humiforte spraying. Humiforte increased mean of MP for genotypes from 406.74 to 537.39. Therefore, it increased tolerance of under study wheat genotypes to terminal drought stress. Also, Humiforte caused to decrease TOL from 193.98 to 187.36. This decreasing is reason of increasing of tolerance to drought. Decreasing amount of TOL for 4057 was very higher than Sabalan. However, it selected as tolerant to drought by this Index. STI, GMP and MSTI decreased at presence of Humiforte. It was concluded that Humiforte as a bio stimulator based on amino acids increased tolerance of wheat genotypes under terminal drought of Ardabil region. And, Humiforte treated plants produced a higher grain yield during drought stress than non treated plants.

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