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Original article

Evaluation the effect of amini acid, fulvic acid and seaweed extract application in normal and drought stress conditions on quantitative and qualitative characteristics of wheat in Behbahan region

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Introduction

Wheat (*Triticum aestivum* L.) is one of the important crops in our country. This plant contains starch, protein, sugar and provides food for human population. In recent years, drought stress has become the main abiotic stress, and could decrease growth and yield of wheat. The application of biostimulants, i.e. amino acids, fulvic acid or seaweed extract were found to positive effect on plant growth which overcomes the harmful effect of some environmental stress such as drought. In recent years, the favorable effects of these substances on vegetative characteristics, yield and grain quality of wheat have been reported. Many studies have shown that the application of biostimulants can increase plant tolerance during abiotic stresses, especially water deficit. Little research have been done about the effects of biostimulants on wheat in Khuzestan yet. Therefore, this experiment was conducted to evaluate the effect of amini acid, fulvic acid and seaweed extract in drought stress on quantitative and qualitative characteristics of wheat.

Materials and methods

This experiment was conducted as split-plot in randomized complete block design with three replications at Behbahan Agricultural Research Station for one year (2017-2018). Irrigation interval considered as main factor in two levels: (70 mm and 130 mm evaporation from class A pan) and the sub factor was growth biostimulants in four levels: control (application of chemical fertilizers according to soil test), amino acid, fulvic acid and seaweed extract. Foliar application of amino ccid, fulvic acid and seaweed extract was done at a concentration of 0.5 % at two stages, tillering and heading. During experiment: plant height, number of spikes per m^2, number of grain per spike, 1000- grain weight, grain yield, nitrogen, phosphorus, potassium, zinc, manganes and iron were recorded. Varince analysis were done by MSTATC statistical software and meanes were compared using Duncan's Multiple Range Test.

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Results and discussion

The results showed a significant increase in grain yield in plants treated with biostimulants compared with control. The highest plant height, number of spikes per m^2, number of grain per spike, 1000-grain weight and grain yield were recorded in amino acid treatment. The highest increase in N, K and grain Fe was achieved by amino acid while the highest increase in P, Zn and Mn of grain was obtained by seaweed extract compared with control. The results indicated that water deficit stress significantly reduced plant height, number of spikes per m^{-2}, 1000 seed weight, grain yield and nutrients. Also, drought stress significantly reduced grain nutrient uptake. Intreraction of the irrigation levels and biostimulants on grain yield indicated that all biostimulants significantly increased the yield in drought stress. The application of amino acids and seaweeds significantly increased grain yield in compared with both controls (under water deficit stress and under water normal conditions) while the use of fulvic acid significantly increased grain yield in comparison to control under water deficit stress. Therefore, the application of amino acid and seaweed extract reduced the effects of water deficit stress.

Conclusions

The results of this study showed that increasing water deficit stress caused significant reduction of all studied traits. However, the application of amino acid and seaweed extract reduced the effects of water deficit stress and increased these traits compared with control under favorable irrigation condition. According to the results, the application of amino acid or seaweed extract is recommended in normal and drought stress condition for wheat cv. Brat.

***Keywords*:** Growth biostimulant, Irrigation, Nutrients, Yield, Yield components

Table 1. Physical and chemical properties of the soil in the experiment place

Soil texture	Fe	Mn	Zn	K	P	TN	OC	TNV	pH	EC	Soil depth
	----------mg/kg----------					g/kg	-----%-----			dS/m	cm
Silty clay-Loam	6.7	11.5	1	250	11	1	0.60	55.5	7.8	3.3	0-30

Table 2. Variance analysis (Mean squars) effect of plant growth biostimulants on plant height, Number of spike per m^2, Number of grain per spike, 1000- grain weight and grain yield of wheat

S.O.V	df	Plant height	Number of spike per m^2	Number of grain per spike	1000- grain weight	Grain Yield
Replication	2	54.08^{*}	1976.04^{*}	6.99^{ns}	2.11^{ns}	633325^{ns}
Irrigation levels (I)	1	82.14^{*}	1395.38^{*}	18.55^{ns}	9.71^{*}	4373117^{*}
Error	2	2.66	34.13	3.13	0.28	62.906
Biostimulants (B)	3	34.68^{*}	3330.15^{**}	10.58^{*}	10.09^{**}	2962642^{**}
B × I	3	0.09^{ns}	140.486^{ns}	0.98^{ns}	2.55^{ns}	18121^{ns}
Error	12	7.54	416.69	2.75	1.15	60488.23
C.V (%)		4.98	5.69	4.16	6.44	7.57

Table 3. Means comparison effect of plant growth biostimulants on plant height, number of spike per m², number of grain per spike, 1000- grain weight and grain yield of wheat

Plant growth stimulation treatment	Plant height	Number of spike per m²	Number of grain per spike	1000- grain weight	Grain yield
	cm			g	kg.ha^{-1}
Control	88.33^{b}	531.67^{b}	38.50^{b}	42.81^{b}	5983.16^{c}
Amino acid	94.33^{a}	574.33^{a}	41.57^{a}	45.80^{a}	7565.48^{a}
Fluvic acid	93.36^{ab}	534.50^{b}	39.17^{ab}	43.51^{b}	6856.18^{b}
Seaweed extract	92.53^{ab}	573.33^{a}	40.08^{ab}	43.56^{b}	7233.77^{ab}

Table 4. Means comparison effect of irrigation levels on plant height, plant height, number of spike per m2, number of grain per spike, 1000- grain weight and grain yield of wheat

Irrigation levels	Plant height	Number of spike per m²	Number of grain per spike	1000- grain weight	Grain yield
	cm			g	kg.ha^{-1}
70 (mm)	94.12^{a}	561.083^{a}	40.71^{a}	44.56^{a}	7325.26^{a}
130 (mm)	90.42^{b}	545.83^{b}	38.83^{a}	43.28^{b}	6471.53^{b}

Table 5. Variance analysis effect of plant growth biostimulants on amounts of nitrogen, phosphorus, potassium, zinc, manganese and iron of wheat grain

S.O.V	df	Nitrogen of grain	Phosphorus of grain	Potassium of grain	Zinc of grain	Manganese of grain	Iron of grain
Replication	2	0.015^{ns}	0.005*	0.0002^{ns}	14.28*	8.260^{ns}	226.0^{ns}
Irrigation levels (I)	1	0.269*	0.005*	0.003*	36.26*	14.260*	416.67*
Error	2	0.007	0.0002	0.00002	0.63	0.510	19.79
Biostimulants (B)	3	0.149**	0.002**	0.007*	61.45**	43.760**	634.7**
B × I	3	0.007^{ns}	0.0005^{ns}	0.0002^{ns}	0.18^{ns}	0.705^{ns}	8.33^{ns}
Error	12	0.020	0.0003	0.0002	5.09	2.899	75.69
C.V (%)		*7.01*	*6.05*	*4.28*	*5.32*	*4.28*	*9.36*

Table 6. Means comparison effect of plant growth biostimulants on nitrogen, phosphorus, potassium, zinc, manganese and iron of wheat grain

Plant growth stimulation treatment	Nitrogen of grain	Phosphorus of grain	Potassium of grain	Zinc of grain	Manganese of grain	Iron of grain
	----------%	----------	----------	----------mg.kg^{-1}	----------	----------
Control	1.803^{b}	0.250^{b}	0.312^{b}	38.583^{b}	36.000^{b}	82.500^{c}
Amino acid	2.187^{a}	0.281^{a}	0.335^{a}	42.250^{ab}	41.000^{a}	103.333^{a}
Fluvic acid	2.032^{ab}	0.263^{ab}	0.315^{b}	42.500^{ab}	39.833^{a}	88.833^{bc}
Seaweed extract	2.000^{ab}	0.286^{a}	0.317^{b}	46.417^{a}	42.250^{a}	100.00^{ab}

Table 7. Means comparison effect of irrigation levels on nitrogen, phosphorus, potassium, zinc, manganese and iron of wheat grain

Irrigation levels	Nitrogen of grain	Phosphorus of grain	Potassium of grain	Zinc of grain	Manganese of grain	Iron of grain
	---------- % ----------			----------mg.kg^{-1}----------		
70 (mm)	2.111^{a}	0.284^{a}	0.330^{a}	43.667^{a}	40.542^{a}	97.083^{a}
130 (mm)	1.899^{b}	0.257^{b}	0.309^{b}	41.208^{b}	39.000^{a}	88.750^{b}

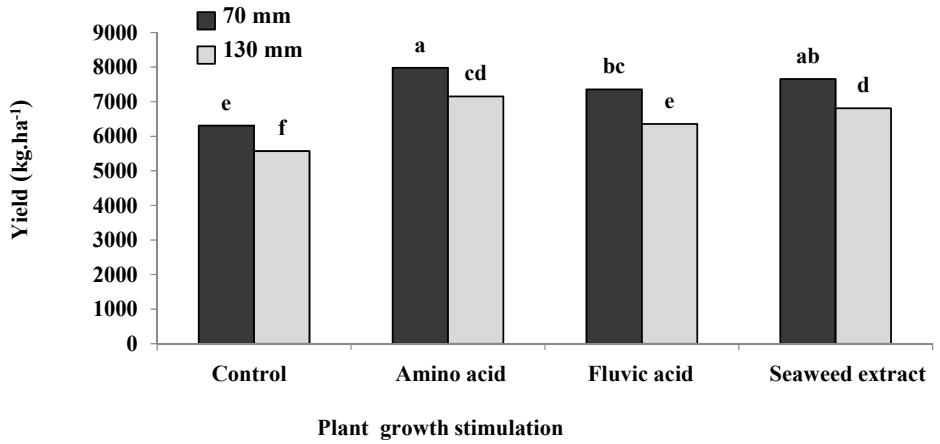

Fig. 1. Means comparison of grain yield in intreraction of the irrigation levels and plant growth biostimulant