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Original article

Effect of spraying various levels of humic acid on some morphophysiological and biochemical properties of purslane (*Portulaca oleracea*) affected by drought stress

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Extended abstract

Introduction

Drought stress not only is one of the most unfavorable factors for plant growth and its productivity but also a serious menace to sustainable crop production and food security under conditions of climate change. In order to, optimum water consumption in agricultural production, appropriate methods should be considered such as changing the planting pattern, cultivation of drought-tolerant plants and some species of medicinal plants. Portulaca oleracea from family Portulacaceae. is a four-carbon compound and annual plant. Portulaca oleracea has antioxidants and high amount of Omega-3 acids which could strengthens the immune system and deactivate free radicals. Therefore, prevents cardiovascular disease, cancer, asthma, diabetes type 1 and infectious diseases. The main objective of this study is to investigate of drought stress and humic acid spraying effects on some physiological characteristics of Purslane.

Materials and methods

A split plot experiment was conducted in a randomized complete block design with three replicate in the research farm of Zabol University (Sistan Dam) during 2016-2017. Drought stress was performed on three levels: (90, 70 and 50) % FC and humic acidic in four levels (0, 25, 50 and 75 mg L^{-1}). During and the end of experiment some traits were measured such as height, number of lateral branches per plant, fresh and dry root weight, leaf chlorophyll index, photosynthetic pigments, carbohydrates and proline. measuring the proline content and Carbon hydrate content of leaves have been done by using the Bates (1973) and Schlegel (1956). methods, respectively. (Analysis of variance was performed by using SAS statistical software version 9.1. Comparison of means was performed by using Duncan's multiple range test at the 5% significance level.

Results

The results showed that the combination of drought stress and humic acid spraying had a significant effect on all studied traits. Maximum plant height was achieved at 70% drought stress and 75 mg L^{-1} of humic acid, the highest root length was 50% and 50 mg L^{-1} of humic acid, the highest fresh and dry weight of root were obtained from 90% and 75 mg L^{-1} of humic acid. The highest amount of carbohydrates and proline were obtained at 50%FC and 50 mg L^{-1} humic acid. The maximum photosynthetic pigments was observed under combination of 50 %FC and 50 mg L^{-1} of humic acid.

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Conclusion

According to the results of this research, despite of increasing proline and carbohydrates under stress conditions, the highest values of traits were obtained under medium stress 70% FC. Therefore, according to water shortage in the study area, medium stress (70% FC) for Production of Portulaca oleracea can be proposed. The use of humic acid in the cultivation of medicinal plants can reduce the harmful effects of chemical fertilizers and increase the quantity and quality of plant production. In addition, could play an important role in sustainable agriculture.

Keywords: Low irrigation, Organic fertilizers, Photosynthetic pigments, Proline

Table 1. Physical and chemical characteristics of soil experimental

K	P	N Total	Organic matter	EC	pH	Soil texture
-------ppm-------		----------------%-----------------		$dS.m^{-1}$		
39.54	3.20	0.05	0.56	1.87	7.98	Sandy loam

Table 2. Meteorological data of Zabol University Research Farm (located in Sistan Dam), 2016-2017 Crop Year

Month	Average Minimum temperature	Average Maximum temperature	Average Temperature	Average Relative humidity	number of days Ice	Rainfall
	--------------------------- °C --------------------------			%		mm
April	14.95	33.5	24.26	34	0	0
May	22.79	36.31	29.55	23	0	0
June	25.7	41.4	33.5	21	0	0

Table 3 .Analysis of variance of morphophysiological and biochemical properties of portulaca underthe influence of drought stress and humic acid Sparying

S.O.V	df	Plant height	lateral Number of branche	Root length	Root fresh weight	Root dry weight
Repeat	2	38.77^{ns}	3.00^{ns}	2.19^{ns}	0.29^{**}	0.002^{ns}
Drough (S)	2	380.52^{**}	523.00^{**}	154.19^{**}	42.66^{**}	1.13^{**}
Error a	4	10.27^{ns}	0.75^{ns}	0.8^{ns}	0.05^{ns}	0.002^{ns}
Humic acid Spary (M)	3	428.66^{**}	51.95^{**}	15.36^{**}	2.84^{**}	0.07^{**}
M× S	6	12.63^{ns}	7.25^{**}	0.41^{ns}	0.24^{ns}	0.001^{ns}
Error b	18	10.03	0.68	0.87	0.05	0.001
CV(٪)	-	*7.32*	*5.87*	*6.98*	*6.97*	*6.29*

Table 3. Continued

S.O.V	df	SPAD	Carbohydrat	Proline	Chlorophyll a	Chlorophyll b	Carotenoides
Repeat	2	0.80^{*}	7.57^{ns}	0.00002^{ns}	0.0004^{ns}	0.0003^{ns}	0.00001^{ns}
Drough (S)	2	58.98^{**}	5050.04^{**}	0.12^{**}	0.37^{**}	0.45^{**}	0.02^{**}
Error a	4	0.10^{ns}	8.19^{ns}	0.00007^{ns}	0.0005^{ns}	0.0006^{ns}	0.00003^{ns}
humic acid Spary(M)	3	6.27^{**}	657.01^{**}	0.007^{**}	0.04^{**}	0.05^{**}	0.0006^{**}
M × S	6	0.40^{ns}	54.60^{**}	0.001^{**}	0.14^{**}	0.01^{**}	0.0007^{**}
Error b	18	0.09	5.12	0.00005	0.0003	0.0004	0.00003
CV(٪)	-	3.97	6.34	5.26	5.97	5.88	3.94

*, ** Statistically significant at the probability levels of 5% and 1%, respectively

Table 4. Compare the average of simple effects of morphophysiological properties of portulaca under the influence of drought stress and humic acid Sparying.

Treatments	Levels	height Plant	Root length	Root fresh weight	Root dry weight	SPAD
		----------cm----------		----------$g\ plant^{-1}$----------		
Drought	**90% FC**	45.00^{b}	9.83^{c}	5.30^{a}	0.81^{a}	10.06^{a}
	70% FC	47.57^{a}	13.25^{b}	3.52^{b}	0.49^{b}	7.46^{b}
	50% FC	36.91^{c}	17.00^{a}	1.53^{c}	0.20^{c}	5.65^{c}
humic acid Spraying	**contorol**	34.88^{d}	11.88^{c}	2.78^{d}	0.38^{d}	6.69^{d}
	25 mg L^{-1}	41.22^{c}	12.77^{c}	3.24^{c}	0.48^{c}	7.50^{c}
	50 mg L^{-1}	45.55^{b}	14.88^{a}	3.70^{b}	0.53^{b}	8.65^{a}
	75 mg L^{-1}	51.22^{a}	13.88^{b}	4.07^{a}	0.60^{a}	8.06^{b}

In each column, means with same letters are not significantly different at 5% probability level.

Table 5. Interaction effect of drought stress and humic acid spraying on growth and biochemical properties of *Portulaca oleracea*.

Drought	Spraying acid humic	Number of lateral branches	Carbohydrate	Proline
			---------- $mg.g^{-1}$ ----------	
90% FC	**contorol**	11.00^{gh}	1.71^{k}	0.06^{i}
	25 mg L^{-1}	12.00^{g-f}	30.61^{h}	0.06^{hi}
	50 mg L^{-1}	12.66^{f}	17.23^{i}	0.07^{gh}
	75 mg L^{-1}	15.33^{e}	8.76^{j}	0.07^{hi}
70% FC	**contorol**	17.33^{d}	32.28^{gh}	0.08^{gh}
	25 mg L^{-1}	19.00^{c}	35.08^{g-f}	0.08^{g}
	50 mg L^{-1}	22.00^{b}	38.33^{ef}	0.15^{e}
	75 mg L^{-1}	26.66^{a}	41.80^{d}	0.10^{f}
50% FC	**contorol**	6.33^{g}	44.61^{d}	0.20^{d}
	25 mg L^{-1}	8.33^{i}	66.28^{a}	0.25^{c}
	50 mg L^{-1}	8.66^{i}	58.57^{b}	0.30^{a}
	75 mg L^{-1}	9.66^{ih}	52.76^{c}	0.28^{b}

In each column, means with same letters are not significantly different at 5% probability level.

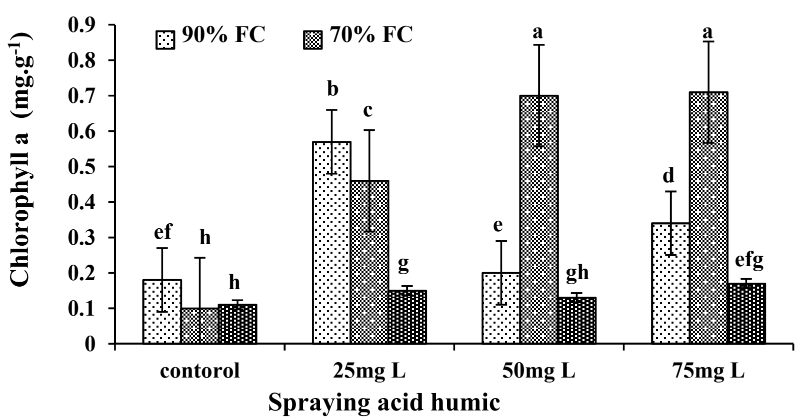

Fig. 1. Interaction effect of drought stress and humic acid on Chlorophyll a (mg g^{-1}) in Purslane

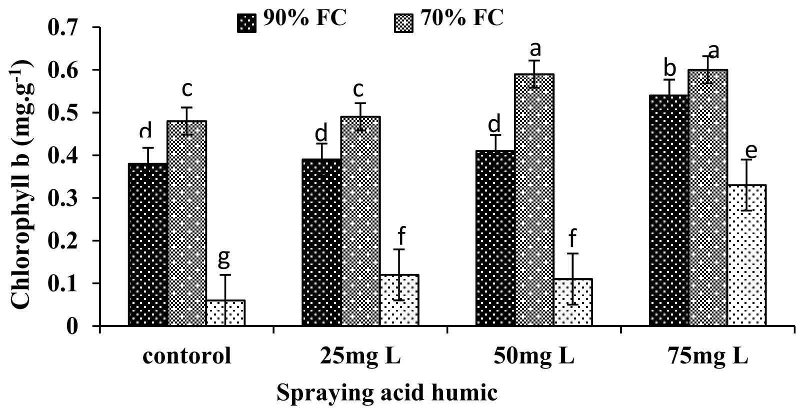

Fig. 2. Interaction effect of drought stress and humic acid on Chlorophyll b (mg g^{-1}) in Purslane

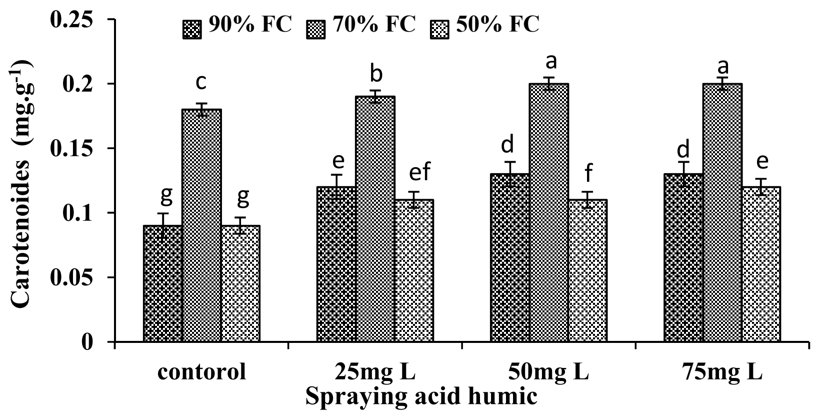

Fig. 3. Interaction effect of drought stress and humic acid on Carotenoids (mg g-1) in Purslane