University of Birjand

تنش‌های محیطی در علوم زراعی
Environmental Stresses In Crop Sciences
Env. Stresses Crop Sci.
Vol. 15, No. 3, pp. 731-740 (Fall 2022)

http://dx.doi.org/10.22077/escs.2021.4034.1957

Original article

The effect of two types of algae on the growth characteristics of bread wheat and basil under salinity stress

M.H. Sayyari Zahan[1*], M.H. Sayyadi Anari[2], S. Mahmoodi[3], Gh.R. Zamani[4], F. Golestanifar[5]

1. Associate Professor, Department of Agronomy and Soil Sci., University of Birjand, Iran
2. Associate Professor, University of Birjand, Iran
3. Associate Professor, Department. of Agronomy, Faculty of Agriculture, University of Birjand, Birjand, Iran
4. PhD Students, University of Birjand, Iran

Received 04 December 2020; Accepted 21 February 2021

Extended abstract

Introduction

Today in many parts of the world and specially in Iran, water and soil salinity is one of the environmental stress and a serious risk to plant growth and crop production. One way to modify the salinity of irrigation water for agriculture, identification and application of different types of algae. The aim of this experiment was to investigate the effect of two types of algae on the growth characteristics of wheat and basil under salinity stress.

Materials and methods

This research was carried out as factorial in two phases of laboratory (in the form of a completely randomized design) and greenhouse (in the form of a randomized complete block design) in the Faculty of Agriculture of University of Birjand located in Amirabad campus in 2015. The first factor is salinity with four levels (1250, 2500, 5000 and 10000 µs cm^{-1} in both laboratory and greenhouse sections and the second factor is the application of algae with 3 levels (green-blue microalgae Spirulina platensis (for saline water)), single-celled algae Chlorella vulgaris (for fresh water) and control no use of algae. Algae were grown separately in water salinity treatments described above in 50 × 50 cm aquariums in the laboratory. The soil was well mixed with a small volume of saline solution as required and water added to maintain soil moisture at 0.18 cm^3 cm^{-3} (35% water-holding capacity), and then soil was incubated for 1 weeks for subsequent use in the pot experiment.

Results and discussion

In the part of laboratory experiment, the results of analysis of variance showed that there was a significant difference between different levels of salinity stress and algae type on dry weight of plumule and rootlet in wheat and basil, but there was no statistically significant difference between their interactions. The application of algae caused a significant increase in the dry weight of plumule and rootlet wheat. The highest dry weight was obtained in the application of Chlorella algae (0.0125 and 0.0008 g pl^{-1} per plumule and rootlet, respectively). However, both of algae reduced significantly the dry weight of plumule and rootlet of basil. In pot experiment, the results of variance analysis showed that algae type ($P < 0.05$) and different levels of water salinity ($P < 0.01$) had a significant effect on wheat plant height and for basil just were significant different salinity levels ($P < 0.01$) but their interaction had no significant effect on the trait. The use of algae increased significantly the wheat height (algae Chlorella 9.34% and the use of algae spirulina 6.56%). The interaction effect of algae type and salinity levels (P

*Correspondent author: Farid Golzardi; E-Mail: msayari@birjand.ac.ir.

<0.01) were significant in wheat dry weight but for basil dry weight the simple effect was significant. Results indicated that the interaction of algae type and salinity stress had a significant effect on electrolyte leakage of wheat and basil.

Conclusion

Therefore, it can be concluded that the type of algae had a different effect on the two types of plants, so that for wheat plant chlorella algae and for basil plant type of spirulina algae had more effect on traits and moderated the effects of salinity stress.

***Keywords*:** Chlorella algae, Environmental stress, Seawater simulation, Spirulina algae

Table 1. Results of ANOVA for evaluated traits of wheat and basil in the laboratory part

		Basil		Wheat	
S. O. V	**Df**	**Radicle dry weight**	**Plumule dry weight**	**Radicle dry weight**	**Plumule dry weight**
Salinity levels (S)	3	3.65 E-8*	3.2 E-7**	3.8E-6**	1.8 E-5**
Type of algae (T)	2	1 E-7 **	4.9 E-7**	1.6 E-5**	1.1 E-5**
S × T	6	3.8 E-9^{ns}	2.5 E-8 ^{ns}	7 E-7 ^{ns}	1.2 E-6 ^{ns}
Error	24	8.1 E-9	2.6 E-8	7.2 E-7	2 E-6
C.V %	-	*49.27*	*13.51*	*11.77*	*12.09*

ns, ** and *: non-significant, significant at 1% level and significant at 5% level, respectively

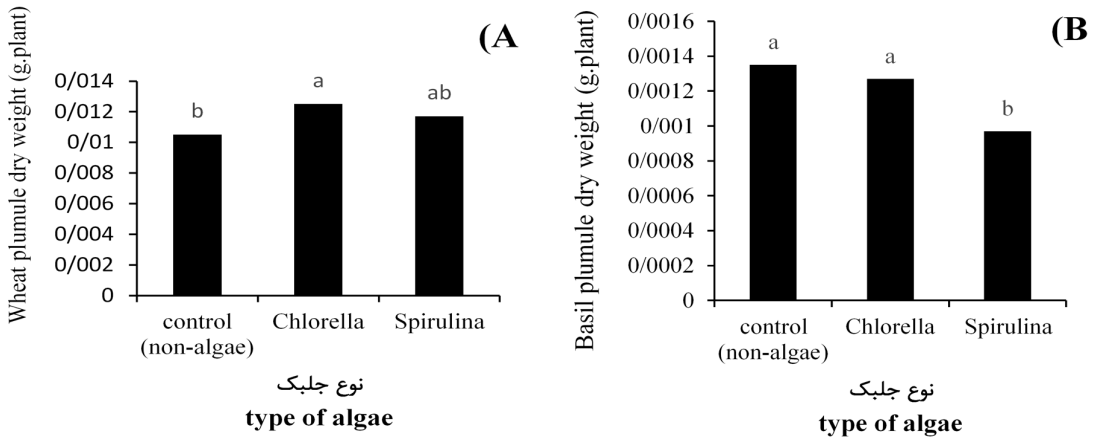

Fig. 1. Simple effect of algae type on radicle dry weight of wheat (A) and basil (B)

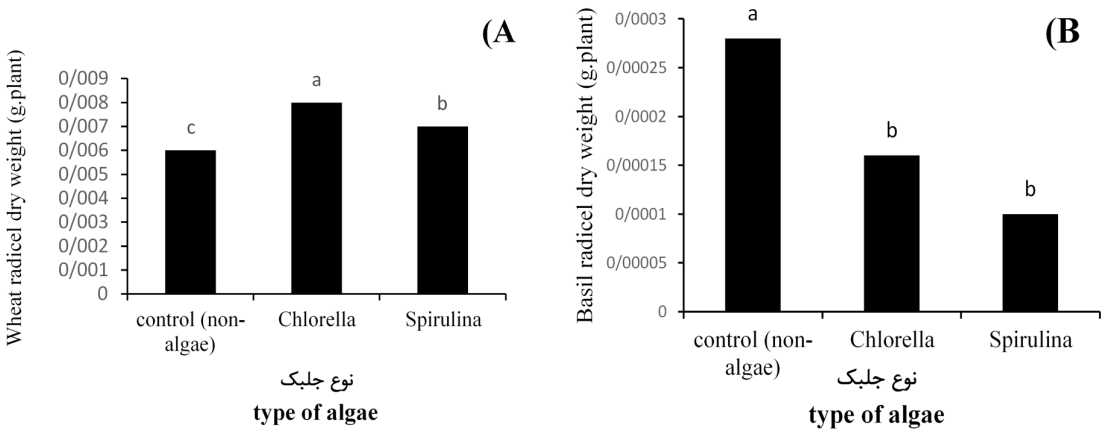

Figure 2. Simple effect of algae type on plumule dry weight of wheat (A) and basil (B)

Table 1. Results of ANOVAof evaluated traits of wheat and basil in the greenhouse part

S. O. V	Df	Basil			Wheat		
		Plant height	Plant dry weight	Electrolyt e leakage	Plant height	Plant dry weight	Electrolyte leakage
Block	2	15.52 ^{ns}	0.001 ^{ns}	20.18^{ns}	5.66 ^{ns}	0.023 ^{ns}	22.58 ^{ns}
Salinity levels (S)	3	888.5**	0.160**	7945.48**	1212.6**	0.976**	847.75 **
Type of algae(T)	2	4.76 ^{ns}	0.062**	369.12 ^{ns}	74.84 *	0.094**	486.48 *
S × T	6	4.72 ^{ns}	0.009 ^{ns}	406.70*	18.83 ^{ns}	0.047 **	1304.93 **
Error	22	5.63	0.005	133.58	13.89	0.011	100.15
C.V%	-	*16.72*	*37.02*	*29.01*	*7.42*	*11.57*	*30.55*

ns, ** and *: non-significant, significant at 1% level and significant at 5% level, respectively

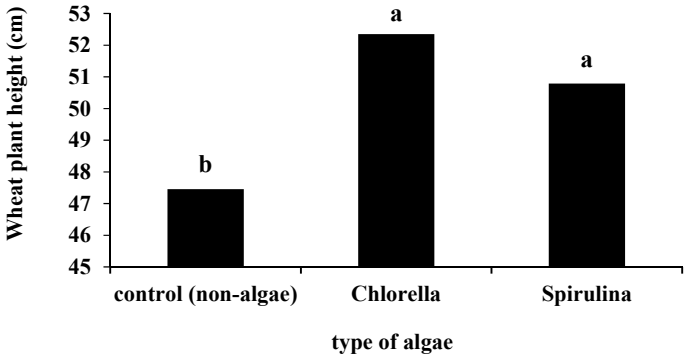

Fig. 3. Simple effect of algae type on wheat plant height

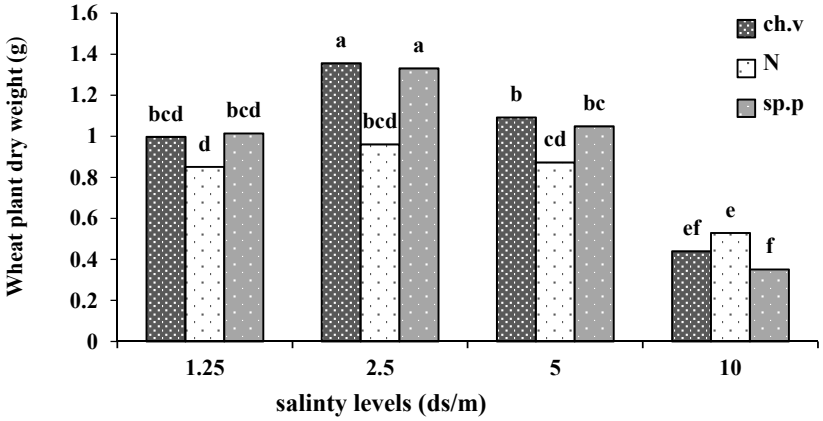

Fig. 4. Interaction of different levels of water salinity and algae application on shoot dry weight of wheat

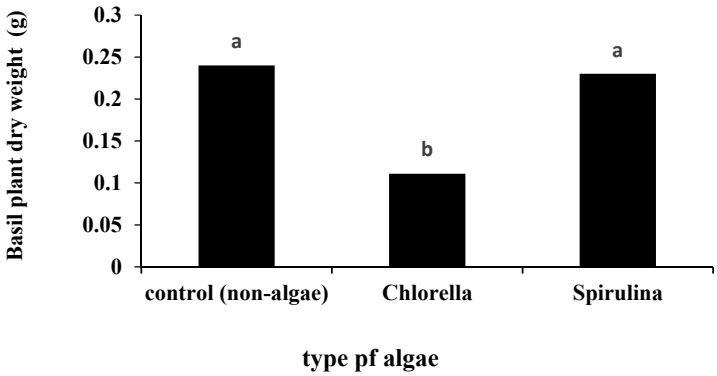

Fig. 5. Simple effect of algae type on shoot dry weight of Basil.

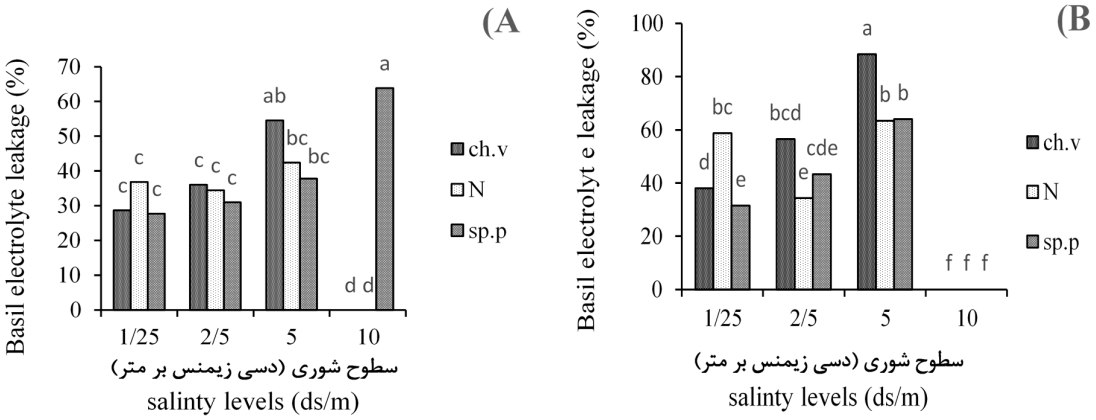

Fig. 6. Interaction of different levels of water salinity and algae application on wheat electrolyte leakage (A) and Basil (B)