Effect of water stress on yield of lettuce (Red Salad Bol) in greenhouse conditions

Elahe zoratipour[1], Amir Soltani Mohammadi[2] and Naser Alemzadeh Ansari[3]

[1.] M. Sc. Student of Irrigation and Drainage, Faculty of Water Sciences Engineering, Shahid Chamran University of Ahvaz, Ahvaz, Iran
e.zoratipour@yahoo.com
[2.] Associate professor of Irrigation and Drainage, Faculty of Water Sciences Engineering, Shahid Chamran University of Ahvaz, Ahvaz, Iran
A.soltani@scu.ac.ir
[3.] Associate professor, Faculty of Agriculture, Shahid Chamran University of Ahvaz, Ahvaz, Iran

Abstract: According to the lack of water and the reduction of the quality of available water resources, finding solutions has been considered that increase production without diminishing the quality of the yield. In this research, yield of lettuce of red salad bol, under different treatments of irrigation water and greenhouse cultivation, was investigated in greenhouse of College of Agriculture, Shahid Chamran University of Ahvaz. The experiment was conducted as a completely randomized design with a treatment of water of irrigation at three levels (I1:100%, I2:80% and I3:60%) in three replications. The results showed that irrigation levels were significant at on yield at 5% probability level. The highest yield (fresh weight) was related to the control treatment of I_1 (0.14 kg) and the lowest was related to the treatment of I_3 (0.09 kg).
[Zoratipour E, Soltani Mohammadi A, Alemzadeh Ansari N. **Effect of water stress on yield of lettuce (Red Salad Bol) in greenhouse conditions.** *Rep Opinion* 2018;10(6):11-13]. ISSN 1553-9873 (print); ISSN 2375-7205 (online). http://www.sciencepub.net/report. 2. doi:10.7537/marsroj100618.02.

Keywords: Water stress; Yield; Lettuce; Greenhouse

1. Introduction

Population growth, the need for more food, and limited water resources in arid and semiarid regions necessitate the use of water resources with marginal quality, deficit irrigation management, or both (Babazadeh et al., 2017). One of the most important yield constraints is the lack of water in arid and semi-arid regions. Drought stress while reducing water content in plant tissues causes growth restriction and some physiological and metabolic changes in them. On the other hand, the availability of different nutrients in soil under the influence of drought stress can be significant changes. Therefore, managing plant nutrition under stress conditions is one of the important issues in the production of plant product (Ahmadian et al, 2011). Lettuce, a cool-season vegetable crop, is most popular according to the consumption rate and economic importance throughout the world (Patil et al, 2013). According to studies have been done, Ors and Suarez. (2017) investigated the effect of drought and salinity stress on spinach. The results showed that the response of spinach to drought and salinity stress was very different, so that spinach yield was initially increased with salinity and then decreased only when irrigation water salinity was 9 dS / m and above, in contrast yields in the first level drought stress decreased compared to the control treatment. Nagaz et al. (2013) investigated the effects of different levels of irrigation with saline water on the salinity of the soil, yield and water use efficiency of lettuce. The highest yield of lettuce and the lowest water use efficiency were related to the control treatment (100% water requirement) and the highest water use efficiency was related to 30% water requirement. Ayas et al. (2011) investigated the effect of low irrigation on the yield of broccoli in greenhouse conditions. Finally, the effects of irrigation water levels on yield, head height, head diameter and dry weight were significant at 5% probability level and the highest yield was 29.2 tons per hectare and was related to the highest level of irrigation. Yazgan et al. (2008) investigated the effect of different levels of irrigation on lettuce yield in greenhouse cultivation conditions in Turkey. The results showed that the highest yield was related to the levels of 100% and 75% of water requirement with the values of 15.1 and 12.01 kg / ha respectively. Badavi et al. (2015) investigated the effect of drought stress (60.80 and 100% water requirement) and mycorrhizal fungus on some of the physiological characteristics of lettuce. The results showed that the effect of drought stress on all traits such as leaf number, leaf area, fresh weight, shoot weight and other parameters except for the percentage of lettuce root colonization was significant at 1% probability level and the highest and lowest fresh and dry weights were observed in 100% and 60% moisture treatments, respectively. Molla Heidari Bafghi et al. (2017) investigated the effect of drought and salinity stress on grain yield of wheat genotypes based on tolerance

indices. The results of analysis of variance showed that there is a significant difference between wheat genotypes with regard to all indices and grain yield of genotypes in both stress conditions at 1% probability level and between tolerance indices and grain yield, stress tolerance index and mean productivity index were recognized as the best indices. The aim of this research was to investigate changes in yield of lettuce (red salad bol) under drought stress in greenhouse conditions.

2. Material and Methods

This research was conducted in 2017 in research greenhouse of Faculty of Agriculture, Shahid Chamran University of Ahvaz with the longitude of 48 degrees and 40 minutes east and latitude of 31 degrees and 20 minutes north with a height of 18 meters above sea level. The soil was used had a medium texture. Soil physical and chemical characteristics including, soil texture and percent of soil-forming particles (by hydrometric method), Salinity and acidity of soil by the preparation of saturated extract, bulk density by metal cylinder with an specific volume and moisture in field capacity point and wilting point were determined by pressure plate. The results are presented in Table 1. The experiment consisted of three treatments of irrigation water (60.80 and 100% water requirement), in a completely randomized design with three replications. The water requirement of the plant was provided according to the maximum allowable depletion rate (30%), for control treatment (100% water requirement) and for other irrigation treatments, considered percentage of this amount. For this purpose, 9 pots were used. The planting date was December in 2017 and the cultivation was indirect (seedling) in pots of diameter 22 and height 30 cm. The plant's growth period is about 70 days. After pouring the filter in the bottom of the pots and filling them from a certain amount of dry soil, the transfer of transplants to the pots was conducted and treatments were performed. The irrigation was done by manual method and by graduated bushel. Also from NPK fertilizer was used as a solution during growth period.

The time of irrigation was determined by weighting method, in such a way, with daily weighing of the pots, the soil moisture content of the pots was obtained. When readily available water used by plants, next irrigation was performed. During the growing season, fifteen times treatments were performed. The volume of water used for treatments I_3, I_2 and I_1 was respectively 3.072, 4.051 and 5.060 liters. At the end of the growth period, the measured parameters were investigated, including yield (fresh weight) for lettuce. Also, SPSS software was used for statistical analysis and Duncan's test was conducted to compare the means.

3. Results

Based on the results of analysis of variance, (table 2) can be found, the amount of irrigation affected by different levels, and at the level of 5%, it is significant on the yield (fresh weight). Accordingly, the comparison of means was performed by Duncan test to study the effects of different levels of irrigation on yield (fresh weight). The results are shown in Table (3). According to Table 3, irrigation was effective on the yield (fresh weight) and with decreasing the amount of irrigation water, yield (fresh weight) significantly decreases.

The highest yield (fresh weight) was related to control treatment (100% water requirement) and 80 and 60% of water requirement reduce performance 16 and 41%, respectively, compared to control treatment, which indicates the effective relationship between irrigation and crop decrease. According to literature review, the results are in accordance with the results of the study of Ayaz et al. (2011) and Badavi et al. (2015) in the study of lettuce performance.

Table 1. Experimental soil properties

pH	ECe (dS/m)	$\rho_b(g/cm^3)$	PWP (%) (Volume)	FC (%) (Volume)	sand percent	Silt percent	Clay percent	Soil texture
7/86	2/15	1/4	12	24	47.6	28	24.4	Sandy clay loom

Table 2- Analysis of variance of measured yield (fresh weight) of lettuce under different irrigation treatments

Sources Change	df	Average of squares
		yield (fresh weight)
Treatment	11	* 0.00
Irrigation	2	* 0.01
Error	24	0.00
Total	35	

*: Significant at the five percent level, ns: is not statistically significant.

Table 3- Comparison of the average effect of irrigation on measured yield (fresh weight) of lettuce based on Duncan test

parameter	irrigation (percent)		
different levels	I_1	I_2	I_3
yield (fresh weight) (Kg)	0.15 c	0.12 b	0.09 a

In each row, treatments with common alphabets are not significant at 5% probability level.

4. Discussions

According to the results of this study, in investigating the amount of different irrigation levels on yield (fresh weight) lettuce, the irrigation levels at designated levels and at 5% probability level, on the yield (fresh weight) was significant. According to the comparison of means based on Duncan's test, the highest yield (fresh weight) was related to control treatment (100% water requirement) equal to 0.14 kg and the lowest was related to I_3 treatment equal to 0.09 kg. Thus, decreasing the amount of irrigation water decreased yield.

Corresponding Author:
Elahe Zoratipour, M. Sc.
Student of Irrigation and Drainage, Faculty of Water Sciences Engineering, Shahid Chamran University of Ahvaz, Ahvaz, Iran.
E-mail:e.zoratipour@yahoo.com

References

1. Ahmadian, A. Ghanbari, A. and Siahsar, B. 2011. Effect of drought stress and consumption of organic and mineral fertilizers and mineral residues on the yield and yield components of German Chamomile (Matricaria chamomilla L.). Journal of Agricultural Ecology, 3(3): 383-395.
2. Ayas, S. Orta, H. and Yazgan, S. (2011). Deficit irrigation effects on broccoli (Brassica Oleracea l.var. Monet) yield in unheate D greenhouse condition. Bulgarian Journal of Agricultural Science, 17 (No 4), 551-559.
3. Babazadeh, H., Sarai Tabrizi, M. and Homaee, M. 2017. Assessing and Modifying Macroscopic Root Water extraction basil (Ocimum basilicum) models under simultaneous water and salinity stresses. Soil Physics and Hydrology, Soil Science Society of America Journal, 5585 Guilford Rd., Madison WI 53711 USA. All Rights Reserved.
4. Badavi, H. Alemzadeh Ansari, N. Mahmudi Surestani, M. and Eskandari, F. 2015. Effect of drought stress and mycorrhizal fungus on some morphophysiological characteristics of lettuce (Lactuca sativa. L). Plant Products (Journal of Agricultural Science), 3(38): 27-39.
5. Molla Heydari Bafghi, R. Baghizadeh, A. and Mohammadinezhad, Gh. 2017. Evaluation of tolerance to salinity and drought stress in wheat genotypes based on tolerance indices. Agronomy Correction Research, 23(9): 27-34.
6. Nagaz, K. El Mokh, F. Moncef Masmoudi, M. and Ben Mechlia, N. 2013. Soil salinity, yield and water productivity of lettuce under irrigation regimes with saline water in arid conditions of Tunisia. International Journal of Agronomy and Plant Production. 892-900.
7. Ors, S. and Suarez, D. L. 2017. Spinach biomass yield and physiological response to interactive salinity and water stress. Contents Lists Available at Science Direct. Agricultural Water Management 190, 31–41.
8. Patil, T. Singh, M. Khanna, M. Singh, D. K. and Hasan, M. 2013. Response of lettuce (Lactuca sativa L.) to trickle irrigation under different irrigation intervals, N Application Rate and Crop Geometry. Indian Journal of Agricultural Economics.573-582.
9. Yazgan, S., Ayas, S., Demirtas, C., Buyukcangaz, H and B. N. Candogan. 2008. Deficit irrigation effects on lettuce (Lactuca sativa var. Olenka) yield in unheated greenhouse condition. Journal of Food, Agriculture and Environment, 6(2): 357 – 361.

6/18/2018