Plant Archives Volume 20 No. 1, 2020 pp. 2751-2754 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

EFFECT OF ALTERNATIVE IRRIGATION, MOISTURE PRESERVATION AND HUMUS ON SOME GROWTH AND YIELD OF CABBAGE

Hameed M. Abed[1], Ali H. Jasim[1]*, Abdullah Y. Eanawi[2], Nadheema S. Al-Shammari[2] and Rehab M. Hasan[2]

[1*]Agriculture College, Al-Qasim Green University, Iraq.
[2]Babylon Agricultural Directorate, Ministry of Agriculture, Iraq.

Abstract

An experiment was conducted in 2018/2019 growth season in the field of Agriculture College, Babylon, Iraq to study the effect of alternative irrigation (irrigation when water capacity reached 50% and the other treatment was skipping from one irrigation to the third irrigation as the plant mature), moisture preservation (with and without) and humus spraying on root zone (with and without) on growth and heads of cabbage. Randomized complete block design with three replications was used. The results showed that water stress by alternative irrigation caused significant reduction in chlorophyll, leaf area, cabbage head diameter, total and marketable heat weight compared with normal irrigation, while moisture preservation caused significant increases in these parameters. Adding humus also significantly increases these parameters. Water stress caused percentage decreasing of marketable cabbage head by 37.3%, while moisture preservation or humus alleviate the reduction of stress to 8.4% and 30.8% respectively. Adding both moisture preservation and humus eliminate the reduction which caused by water stress.

Key words: Alternative irrigation, moisture preservation, humus, cabbage.

Introduction

Cabbage (*Brassica oleracea* var. capitata) is a very popular vegetable around the world. The major cabbage growing areas in Iraq and Asia are often threatened by drought stress. Water deûcit results in a decline of seedling growth (Kaya *et al*., 2006). Drought stress determine the possibility of increasing the cultivated area and decreased crop productivity in the world (Lipiec *et al*., 2013). Under drought stress, seedlings were inhibited due to low water potential, which causes decline of water uptake (Farooq *et al*., 2009). Water stress causes oxidative damage that results by reactive oxygen species (ROS) which increased as the plants exposed to drought stress (Gill and Tuteja, 2010). It is necessary to alleviate the harmful effects of drought stress to product good crop yields (Ashraf and Rauf, 2001). Water stress in plants caused a reduction in plant-cell's water potential and turgor, that elevate the solutes' concentrations in the cytosol and extracellular matrices. The decreases in Cell enlargement leading to growth inhibition (Jisha and Puthur, 2016) with low or failure of reproductive (Erdem *et al*., 2010; Durak and Yildirim, 2017). Drought not only affects by reducing water content, turgor and total water content, it also affects stomata opening, reducing transpiration and arrests photosynthesis rates (Kacer *et al*., 2006). It causes negative effects on mineral uptake and transporting as well as metabolism that leads to decrease leaf area. Under water stress cell expansion is slows down and plant growth is retarded and water stress influences cell enlargement more than cell division as well as altered photosynthesis, respiration, translocation, ion uptake, carbohydrates, nutrient metabolism and hormones (Lisar *et al*., 2012). Moisture preservation alleviate the unfavorable effects of water stress. Some water preservation like "super absorbent polymers" absorb water and release it slowly to reduce water stress and increasing plant growth (Rasanjali *et al*., 2019 and Monnig, 2005). Humus as organic fertilizer play important role in changing soil physical and chemical characters as well as soil holding of water and cations (Cacco and Aqnolla, 1984). Some research found that humus caused an increases in plant yield (AL-Mharib *et al*., 2019, Zahwan, 2015).

***Author for correspondence :** E-mail: ajasim11@gmail.com

Table 1: Effect of alternating irrigation, moisture preservation and humus on cabbage leaf area (cm^2).

Irrigation	Irrigation preservation	humus		Irrigation*irr. preservation	Irrigation means
		without	with		
Regular irrigation	Without preservation	980	1190	1085	1100
	With preservation	1048	1180	1114	
Alternating irrigation	Without preservation	707	804	756	893
	With preservation	925	1134	1030	
LSD $_{0.05}$		75		53.03	37.5
Interaction of irrigation* humus				Mean of Humus effect	
Regular irrigation		1014	1185	without	915
Alternating irrigation		816	969	with	1077
LSD $_{0.05}$		53.03			37.5
Interaction of irrigation preservation* humus				Mean of preservation	
Without preservation		844	997	920	
With preservation		987	1157	1072	
LSD $_{0.05}$		53.03		37.5	

Table 2: Effect of alternating irrigation, moisture preservation and humus on head diameter (cm).

Irrigation	Irrigation preservation	humus		Irrigation*irr. preservation	Irrigation means
		without	with		
Regular irrigation	Without preservation	19.6	21.1	20.4	20.8
	With preservation	20.5	21.8	21.2	
Alternating irrigation	Without preservation	14.1	15.7	14.9	17.2
	With preservation	18.7	20.3	19.5	
LSD $_{0.05}$		2.9		2.05	1.45
Interaction of irrigation* humus				Mean of Humus effect	
Regular irrigation		20.1	21.5	without	18.3
Alternating irrigation		16.4	18.0	with	19.8
LSD $_{0.05}$		53.03			1.45
Interaction of irrigation preservation* humus				Mean of preservation	
Without preservation		16.9	18.4	17.7	
With preservation		19.6	21.1	20.4	
LSD $_{0.05}$		2.05		1.45	

Table 3: Effect of alternating irrigation, moisture preservation and humus on chlorophyll in cabbage .

Irrigation	Irrigation preservation	humus		Irrigation*irr. preservation	Irrigation means
		without	with		
Regular irrigation	Without preservation	77.0	84.0	80.5	80.5
	With preservation	77.5	83.4	80.5	
Alternating irrigation	Without preservation	71.1	72.3	71.7	75.8
	With preservation	76.7	82.9	79.8	
LSD $_{0.05}$		6.8		4.8	3.4
Interaction of irrigation* humus				Mean of Humus effect	
Regular irrigation		77.3	83.7	without	75.6
Alternating irrigation		73.9	77.6	with	80.7
LSD $_{0.05}$		53.03			3.4
Interaction of irrigation preservation* humus				Mean of preservation	
Without preservation		74.1	78.2	76.1	
With preservation		77.1	83.2	80.1	
LSD $_{0.05}$		6.8		3.4	

Materials and Methods

A field experiment was conducted in the fields of the Faculty of Agriculture College, Al-Qasim Green University, for the agricultural season 2017/2018 to study the effect of irrigation intervals (regular irrigation when water capacity reached 50% and alternating irrigation), moisture-preserving nano-materials (with and without) and humus o the soil (with and without). The experiment was carried out according to randomized complete block design with three replications. The experimental unit consisted of two lines (3 m long and 40 cm between plants. Seedlings were prepared in the nursery and after 35 days were transferred to the field and irrigated directly. After the second irrigation soil humus treatment was done and at third irrigation applied the process of cutting irrigation (as regular when reached 50% of soil capacity or alternative irrigation from one irrigation to another) until maturity and harvesting. The irrigation was done after soil moisture reached to 50% of the field capacity (by soil samples weight). At cabbage head maturity, the data was taken on head diameter, leaf area (by weighting method), chlorophyll (SPAD), total and marketable head weight. The data were analyzed according to GenStat and the averages were compared according to least significant difference test with a probability level of 5%.

Results and discussion

Table 1, showed that alternating irrigation caused significant reduction in leaf area with a reduction percentage of 18.8%. This may be due to decreasing plant-cell's water potential and turgor and then reduces cell enlargement and division. This result was agreed with Erken *et al*., (2013), Erdem *et al*., (2010) and Schreiner *et al*., (2009). Adding moisture-preserving caused significant increase in head diameter with increasing percentage of 16.5%. Humus application caused

Table 4: Effect of alternating irrigation , moisture preservation and humus on total cabbage head wt.

Irrigation	Irrigation preservation	humus		Irrigation*irr. preservation	Irrigation means
		without	with		
Regular irrigation	Without preservation	3.740	4.280	4.010	4.075
	With preservation	3.970	4.310	4.140	
Alternating irrigation	Without preservation	2.530	2.970	2.750	3.322
	With preservation	3.667	4.121	3.894	
LSD 0.05		0.334		0.236	0.167
Interaction of irrigation* humus				Mean of Humus effect	
Regular irrigation		3.855	4.295	without	3.477
Alternating irrigation		3.099	3.546	with	3.921
LSD 0.05		0.236			0.167
Interaction of irrigation preservation* humus				Mean of preservation	
Without preservation		3.135	3.625	3.380	
With preservation		3.819	4.216	4.017	
LSD 0.05		0.236		0.167	

significant increase in head diameter with an increase percentage of 17.8%. This may be due to that humus increase soil water holding that alleviate water stress. This result was agreed with AL-Mharib *et al.,* (2019).

Table 2, showed that alternating irrigation caused significant reduction in head diameter with a reduction percentage of 17.3%. This may be due to decreasing leaf area (Table 1) and then decreasing carbon assimilation (photosynthesis), that reflects on plant growth (Chaves *et al.,* 2002). This results was agreed with.

Adding moisture-preserving caused significant increase in head diameter with increasing percentage of 15.3%. Humus application caused significant increase in head diameter with an increase percentage of 8.2%.

Table 3, showed that alternating irrigation caused significant reduction in chlorophyll (SPAD) with a reduction percentage of 5.8%. This results was agreed with Ashraf *et al.,* (1994), Jisha and Puthur, (2016) who found that water stress caused degradation in chlorophyll pigments content. Adding moisture-preserving caused significant increase in head diameter with increasing percentage of 5.3%. This results was agreed with Moghadam, (2016). Humus application caused significant increase in head diameter with an increase percentage of 6.7%. This results was agreed with Manea, (2017).

Table 4, showed that alternating irrigation caused significant reduction in total cabbage head with a reduction percentage of 18.5%. Adding moisture-preserving caused significant increase in head diameter with increasing percentage of 12.8%. Humus application caused significant increase in head diameter with an increase percentage of 18.8%. This may be due to improve the growth of root system and increases nutrients absorption from the soil and increased cell division (Metariov, 2002). Humic acid increased the activities of ATPase enzyme in root cells and increased plant root area then increase water absorption and nutrients which reflected in increases vegetative growth (Canellas *et al.*, 2009). This results was agreed with Manea, (2017).

Table 5, showed that alternating irrigation caused significant reduction in marketable cabbage head weight with a reduction percentage of 23.3%. Adding moisture-preserving caused significant increase in head diameter with increasing percentage of 22.8%. Humus application caused significant increase in head diameter with an increase percentage of 16.1%. This may be due to that humus increase soil water and nutrient holding that alleviate water stress. This result was agreed with AL-Mharib *et al.,* (2019). This results was agreed with Manea, (2017).

Table 5: Effect of alternating irrigation, moisture preservation and humus on marketable head wt. (kg).

Irrigation	Irrigation preservation	humus		Irrigation*irr. preservation	Irrigation means
		without	with		
Regular irrigation	Without preservation	2.680	3.120	2.900	2.948
	With preservation	2.830	3.160	2.995	
Alternating irrigation	Without preservation	1.680	1.852	1.766	2.262
	With preservation	2.455	3.068	2.757	
LSD 0.05		0.308		0.218	0.154
Interaction of irrigation* humus				Mean of Humus effect	
Regular irrigation		2.755	3.140	without	2.412
Alternating irrigation		2.068	2.460	with	2.800
LSD 0.05		0.218			0.154
Interaction of irrigation preservation* humus				Mean of preservation	
Without preservation		2.160	2.486	2.343	
With preservation		2.643	3.114	2.877	
LSD 0.05		0.218		0.154	

Conclusion

From this experiment we concluded that water stress decreased the marketable cabbage head weight by 37.3%, while adding both moisture preservation and humus eliminate all the reduction of cabbage head weight which caused by water stress.

References

AL-Mharib, M.Z.K., A.M. Attalah and A.B. Ali (2019). Effect of adding humic acid and phosphate fertilizer levels on growth and yield of lettuce. *J. Agric. and Veterinary Sci*., **12(4)ser. I :** 12-15.

Ashraf, M.Y., A.R. Azmi, A.H. Khan and S.A. Ala (1994). Effect of water stress on total phenols peroxidase activity and chlorophyll content in wheat (*Triticum aestivum* L.). *Acta Physiol. Plant*., **16(3):** 185-191.

Ashraf, M. and H. Rauf (2001). Inducing salt tolerance in maize (*Zea mays* L.) through seed priming with chloride salts, growth and ion transport at early growth stages. *Acta Physiol. Plant*., **23:** 407-414.

Cacco, G. and G.D. Aqnolla (1984). Plant growth regulator activity of soluble humic substances. *J. soil Sci*., **64:** 25-28.

Canellas, L.P., D.J. Dantas and N.O. Aguair (2011). Probing hormonal activity of fractionated molecular humic components in tomato auxin mutant. *Ann. App. Biol*., **159:** 202 -211.

Chaves, M.M., J.S. Pereira, J. Maroco, M.L. Rodrigues, C.P.P. Ricardo, M.L. Osorio, I. Carvalho, T. Faria and C. Pinheiro (2002). "How plants cope with water stress in the field? Photosynthesis and growth," *Annals of Botany.*, **89:** 907-916.

Durak, E. and M. Yildirim (2017). Yield and quality compounds of broccoli (*Brassica oleracea* L. cv. Beaumont) as affected by different irrigation levels. *COMU J. Agric. Fac*., **5(1):** 13-20.

Erdem, Y., L. Arin, T. Erdem, S. Polat, M. Deveci, H. Okursoy and H.T. Gultas (2010). Crop water stress index for assessing irrigation scheduling of drip irrigated broccoli (*Brassica oleracea* L. var. italica). *Agricultural Water Management.*, **98:** 148-156.

Erken, O., C.O. Kuzucu and R. Cakir (2013). Impact of different water supply levels on yield and biochemical ingredients in broccoli. *Bulgarian Journal of Agricultural Science*., **19(5):** 1009-1017.

Farooq, M., M. Irfan, T. Aziz, I. Ahmad and S.A. Cheema (2013). Seed priming with ascorbic acid improves drought resistance of wheat. *Journal of Agronomy and Crop Science.*, **199:** 12-22.

Gill, S.S. and N. Tuteja (2010). Reactive oxygen species and antioxidant machinery in abiotic stress tolerance in crop plants. *Plant Physiology and Biochemistry.*, **48:** 909-930.

Jisha, K.C. and J.T. Puthur (2016). Seed priming with beta-amino butyric acid improves abiotic stress tolerance in rice seedlings. *Rice Science.*, **23(5):** 242-254.

Lipiec, J., C. Doussan, A. Nosalewicz and K. Kondracka (2013). Effect of drought and heat stresses on plant growth and yield: a review. *International Agrophysics.*, **27:** 463-477.

Lisar, S.Y.S., R. Motafakkerazad, M.M. Hossain and I.M.M. Rahman (2012). Water Stress in Plants: Causes, Effects and Responses. In, Water Stress, Ismail M.M. Rahman (Ed.), InTech, Rijeka, Croatia.

Manea, A.I. (2017). Fertilizer type on cabbage growth and yield. *Int. J. Veg. Sci*., **23(6):** 567-574.

Manea, H.R.T. (2017). Super absorbent polymer mitigates deleterious effects of arsenic in wheat. *Rhizosphere*., **3(1):** 40-43.

Metaroiv, I.A. (2002). Effect of humates on disease plant resistance. *Ch. Agric. J*., **1:** 15 -19.

Monnig, S. (2005). Water saturated super absorbent polymers used in high strength concrete. *Otto. Graf. J*., **16:** 193-202.

Rasanjali, K.G.A., C.S. De Silva and K.D.N. Priyadarshani (2019). Influence of super absorbent polymers (saps) on irrigation interval and growth of black pepper (*Piper nigrum* L.) in nursery management. *Open University Sri Lanka J*., **14(1):** 7-25.

Zahwan, T.A. (2015). Effect of humic acid and foliar spray with liqurat extract in growth and yield of onion plant and bulb content of some flavonoids. *J. Tikrit Univ. for Agric. Sci*., **1(4):** 26-37.