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Effect of Stress Water Irrigation on Maize Under Drip Irrigation Conditions

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Abstract: Two field experiments were carried out at Tanta farm, El-Gharbia governorate during 2016 and 2017 seasons to study the effect of no.of drip lines/ridge and irrigation water levels on maize yield and its components under surface drip irrigation method. The treatments were arranged in a RCB design with three replicates. The combined analysis over the two growing seasons showed that, the highest values for grain yield/ha. recorded with 100% ETc (8.40 ton.ha^{-1}) and 90% Etc (8.17) which there were no significant differences between them in the combined data. While, the interaction between one drip line/ridge (DL_1) and I_{100}, I_{90} and I_{80} recorded the highest grain yield (ton.ha^{-1}). Also, the interaction between double drip line/ridge (DL_2) and I_{100} and I_{90} in the combined data. While, the lowest grain yield values were observed with the interaction between I_{70} and both DL_1 and DL_2 in the combined data. So, it could be concluded that we can use one dripline/ridge irrigation with 80% of ETc for obtaining high and good grain yield for maize.

Keywords: Maize, drip irrigation, water productivity (PW), water use efficiency.

1. Introduction

The rationalization of water use for irrigation has become a priority issue due to the increasing population and the increasing demand for water by various sectors of society, and agriculture is considered the most important sector of water consumption [1]. Therefore, many researchers seek to find ways and means that contribute to rationalizing water consumption, by controlling the amount of water given in each irrigation and the number of irrigation (irrigation scheduling), and the need of the plant in its various stages of growth to reach the highest productivity and optimum use of water [2]. The water needs of the crop depend on several factors, including the nature of the crop, the variety, the type of soil, the susceptibility of the soil to water retention, its other hydraulic properties, and climatic conditions and the use of fertilizers and some agricultural practices. Among these different inputs is the amount of water and time to add it so as not to cause a decrease in crop productivity [3]. When the quantities of water are limited, the goal of the farmer should be to increase the efficiency of using the water unit instead of the land unit. This is done by reducing the amount of water used for irrigation that does not affect the productivity of crops, and a well-designed irrigation system can improve water productivity in an area where irrigation is not complete [4].

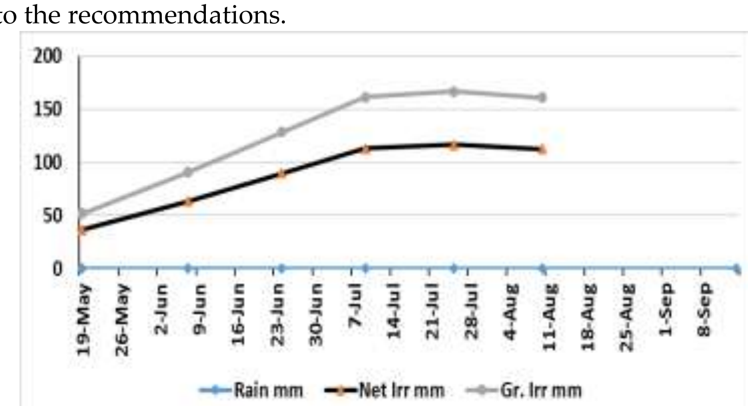
Drip irrigation, also known as trickle irrigation or micro-irrigation is an irrigation method that minimizes the use of water and fertilizers by allowing water to drip slowly to the roots of plants, either onto the soil surface or directly onto the root zone (rhizosphere), through a network of valves, pipes, tubing, and emitters [5]. The amount of water added can be reduced by using drip irrigation without affecting crop growth and productivity [6].

Maize is ranked third among Cereal crops after wheat and rice, as it is considered one of the most important crops used as animal feed. Corn is also considered one of the most important cereal crops in Egypt, with the total annual area planted with corn varieties estimated between 1.5 and 2.0 million acres and producing about 5.47 million tons in 2017, while the demand is not less than 7.0 million tons. This reflects the scale of the problem and the efforts needed to increase the area removed from corn, but due to the limited water resources in Egypt, therefore, providing water is a vital requirement to confront the problem of water shortage [7].

Hence the importance of the study in determining the actual water needs of the maize crop under drip irrigation conditions in the Delta lands and the effect of deficient water on the productivity of the maize crop

2.Material and Methods

The experiment was conducted during the 2016 and 2017 seasons at Tanta Farm, Gharbia Governorate, Egypt to measure the efficiency of water use for drip irrigation on maize yield and its components (Single Cross 10). The soil was clay loam, with sand, silt and clay contents of 26.2%, 37.5% and 36.3%, respectively, with an average pH of 7.8, while the average field capacity was 38.2%, average point Melting of 20.81% and with average EC 1.6 dS.m^{-1}. Drip irrigation used from beginning to end of seasons with pH 7.1 and EC 1.2 dS.m^{-1}. The experiment was administered in randomized complete block design combined over years (two factor and 3 replications). Eight treatments were studied; one drip lines for each ridge (DL_1) and double drip line for each ridge (DL_2) and four water irrigation treatments, (I_{100}: Full irrigation of crop evaporation (ETc), I_{90}, I_{80} and I_{70}, which 90%, 80% and 70% of the ETc, respectively. Maize sowing in double row (ridge) 1.4 cm between ridges and sowing dates were 18 and May 21, 2016 and 2017, respectively. To calculate the amount of water added by drip irrigation, climate data was collected for thirty years for the study area using the FAO- CLIMWAT 2.0 program to calculate the water requirements for maize using version 8 of CROWAT program after modified climate data, soil analysis, crop type and date of planting (Figure 1). The other's agricultural practices of corn cultivation were carried out according to the recommendations.



Note: - Net Irr- Net irrigation, Gr.Irr- Gross irrigation

Figure 1: Crop water requirement of the control treatment (100% ETC)

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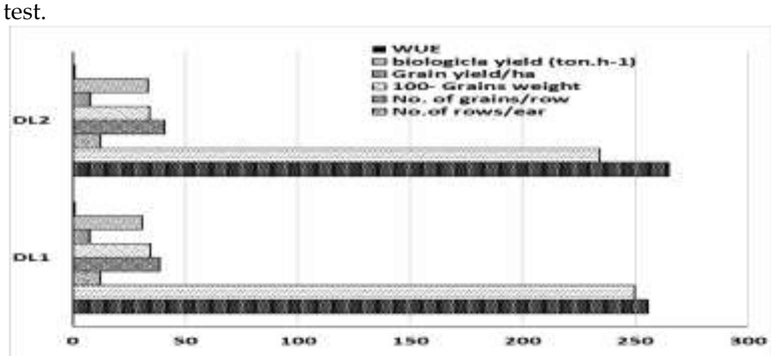
3.Results and Discussion

Data presented in (Table 1 and Figure 2) showed significant effects for spacing between drip line for plant height, ear weight/plant, no.of grains/row and biological yield/ha. in the combined data. There was a great difference between plant height, no.of grains/row and biological yield/ha. as affected by using a double drip line for each ridge treatment (DL_2) compared with using one drip line for each ridge (DL_1), while the same table recorded the highest values of ear weight/plant were found when using one drip line for each ridge in the combined data. On the other hand, no of rows/ear, 100-grains weight, grain yield/ha. and water use efficiency showed insignificant effects in the combined data. There were no significant differences between both lateral spacing (0.7 cm and 1.4 cm) for yield and yield components in both seasons and their combined data, except ear weight/plant, which gave significant values with 1.4 m between lateral spacing only in the second seasons [5,8]. While, there were no significant differences between both dripline spacing were observed for plant weight and ear weight [9].

Table 1: Means for Plant height (cm), Ear weight /plant, No.of rows/ear, No. of grains/row, 100-Grains weight (g), Grain yield/ha, Biological yield/ha and Water use efficiency at no.of drip lines/ridge in the combined data.

	DL_1	DL_2
Plant height (cm)	255.77b	264.87a
Ear weight /plant	249.75a	234.17b
No.of rows/ear	12.32	12.19
No. of grains/row	38.49b	40.80a
100- Grains weight (g)	34.39	34.25
Grain yield (ton.ha^{-1})	7.67	7.71
Biological yield (ton.ha^{-1})	30.95b	33.45a
WUE	1.18	1.19

Means designated by the same letter at each cell are not significant at the 1% level according to Duncan's multiple range test.



DL_1: one drip lines for each ridge, DL_2 double drip line for each ridge

Figure 2: Means of no.of dripline laterals/ridge for maize growth, yield, yield components and water use efficiency in the combined data.

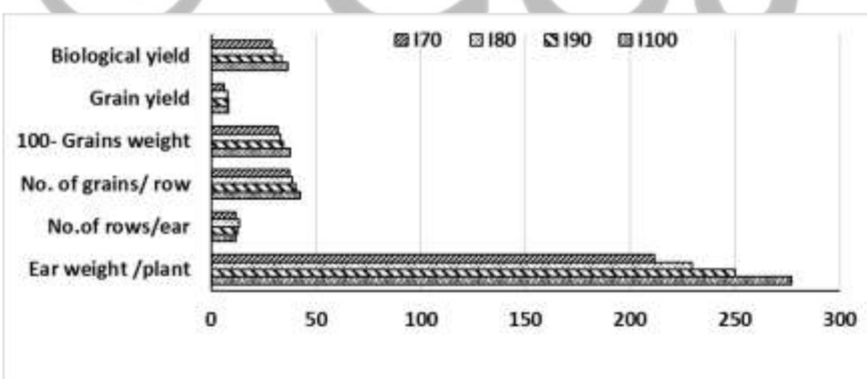
Data in (Table 2 and Figure 3) showed that, the analysis of variance was highly significant affected for all studied characters, except plant height and water use efficiency were insignificant in the combined analysis. Full irrigation 100% ETc recorded the highest values for ear weight/plant (271.18 g), ear weight/plant (277.03 g), no. of grains/row (42.37), 100-grain weight (37.70), grain yield/ha. (8.40 ton/ha.)

and biological yield/ha. (36.35 ton/ha.), while the deficient irrigation to 80% from ETc showed the highest values of no.of rows/ear (13.22). On the other hand, the highest values for grain yield/ha. recorded with 100% Etc (8.40 ton/ha.) and 90% Etc (9.17) which there were no significant differences between them in the combined data (Table 2). Similar results were found by Admasu et al. [10] he reported that, there were no significant differences between full irrigation (100% ETc and 85% ETc) on grain yield. Deficit irrigation up to 70% ETc significantly affected the maize yield and its components and most affected was number of grains/row and 100-grains weight. Deficit irrigation applications decreased the grain yield by 60%. The results of this study also indicated that the lowest 100-grain weight was obtained under 70% ETc [10,11]. Payero et al. [12] found that, there were linear relationships between irrigation water applied and maize grain yield subjected to deficit irrigation treatments. Maize is one of the most important field crops most efficient in producing an amount of dry matter per unit amount of water [13, 14,15, 16, 17,18].

Table (2): Means for Plant height (cm), Ear weight /plant, No.of rows/ear, No. of grains/ row, 100-Grains weight (g), Grain yield/ha, Biological yield and Water use efficiency at different irrigation levels in the combined data.

Irrigation levels	**Plant height (cm)**	**Ear weight /plant**	**No.of rows/ear**	**No. of grains/ row**	**100-Grains weight**	**Grain yield / faddan**	**Biological yield**	**WUE**
I_{100}	271.18	277.03a	11.71c	42.37a	37.70a	8.40a	36.35a	1.10
I_{90}	254.90	249.96b	12.58b	40.22b	34.50b	8.17ab	33.38b	1.19
I_{80}	257.23	229.41c	13.22a	38.73bc	33.09c	7.89b	30.38c	1.29
I_{70}	257.98	211.45d	11.52c	37.26c	31.98d	6.29c	28.69d	1.17

Means designated by the same letter at each cell are not significant at the 1% level according to Duncan's multiple range test.



I100: Full irrigation of crop evaporation (ETC), I90, I80 and I70, which 90%, 80% and 70% of the ETC, respectively

Fig. (3): Means for Ear weight /plant, No.of rows/ear, No. of grains/ row, 100- Grains weight (g), Grain yield/ha and Biological yield/ha at different irrigation levels in the combined data

Table 3 showed highly significant differences between the interaction between drip line spacing and water stress treatments for all studied traits, except water use efficiency which showed no significant differences in the combined analysis. The interactions between DL_1 and I_{100} were recorded the highest values for plant height (275.52 cm), ear weight/plant (282.12 g), and grain yield (8.45 ton.ha^{-1}) compare with using double drip lines for each ridge in the combined data. On the other hand, the highest values for no. of grains/ row (43.79), 100- Grains weight (37.88 g) and Biological yield/ha (36.64 ton.ha^{-1}) were found with the interactions between DL_1 and I_{100} in the combined data. While the highest grain yield/ha.

was found with the interaction between DL_1 and I_{100}, I_{90} and I_{80} and the interaction between DL_2 and I_{100} and I_{90} in the combined data. The lowest grain yield values were observed with the interaction between I_{70} and both DL_1 and DL_2 (6.08 and 6.81 ton.ha^{-1}), respectively in the combined data.

Table (3): Means for the interactions effect between no.of driplines/ridge and irrigation levels for Plant height (cm), Ear weight /plant, No.of rows/ear, No. of grains/ row, 100- Grains weight (g), Grain yield/ha, Biological yield and Water use efficiency in the combined data.

Driplines/ ridge	Irrigation levels	Plant height (cm)	Ear weight /plant (g)	No.of rows/ear	No. of grains/ row	100- Grains weight (g)	Grain yield (ton.ha^{-1})	Biological yield (ton.ha^{-1})	WUE
DL1	I_{100}	275.52a	282.12a	11.85de	40.95bc	37.52a	8.45a	36.06a	1.10
	I_{90}	241.50c	265.44b	12.18cd	38.81de	34.90b	8.23ab	32.86bc	1.19
	I_{80}	248.40bc	239.85c	13.77a	37.74ef	33.09c	7.91ab	28.97e	1.29
	I_{70}	257.65abc	211.62d	11.49e	36.47f	32.03d	6.08c	25.90f	1.13
DL2	I_{100}	266.83ab	271.94ab	11.56e	43.79a	37.88a	8.34ab	36.64a	1.09
	I_{90}	268.31a	234.49c	12.99b	41.64b	34.10bc	8.11ab	33.90b	1.18
	I_{80}	266.05ab	218.98d	12.66bc	39.73cd	33.10c	7.87b	31.79cd	1.29
	I_{70}	258.30abc	211.29d	11.56e	38.04def	31.92d	6.51c	31.47d	1.21

Means designated by the same letter at each cell are not significant at the 1% level according to Duncan's multiple range test.

4.Conclusion

Using one drip line laterals/ridge considered as the best treatment because it is the best economic treatment rather than the other double drip lines laterals/ridge and gives the highest maize yield, where it reduces 50% of the cost of constructing the irrigation network. Also, we can also save 20% of the water requirements when using one drip line laterals/ridge with 80% of ETc. without effects on maize grain yield.

References

1. Fahad, A.A.; Al-Hadeethi, S. A.; Malih, K. M. Water Requirement of Corn (Zea mays L.) for Fall Season of Central Iraq Under Full and Deficit Irrigation. Journal of Agricultural sciences 2005. 32 (3): 315-323.
2. Furgassa, Z.S. The Effect of Deficit Irrigation on Maize Crop Under Conventional Furrow Irrigation in Adami Tulu Central Rift Valley of Ethiopia. Applied Engineering. 2017. 1(1): 1-12.
3. Hillel, D. Application of Soil Physics. Academic Press.Inc. New York: 1980. 116–126.
4. Fereres, E.; Soriano, M.A. Deficit irrigation for reducing agricultural water use. J. Exp. Botany 2007. 58(2): 147–159.
5. Abd El-Razek, U.A. Effect of modern irrigation system on some maize varieties. Ph.D. Thesis, Agronomy Dept., Tanta University, Tanta, Egypt. 2007.
6. Eissa, M. A. Nutrition of drip irrigated corn by phosphorus under sandy calcareous soils. Journal of Plant Nutrition 2016. 39 (11):1620–1629.
7. El-Atawy, Gh. Sh.; Eid, S. M. Influence of irrigation water amounts and nitrogen rates on maize productivity and some water relations in Wadi Elnatroon region, Egypt. J. Soil Sci. and Agric. Engineering, Mansoura Univ., 2010. 1 (8): 775 – 787.

8. Bharathi, A.; Ragavan, T.; Geethalakshmi, V.; Rathinasamy, A.; Amutha, Dr. R. Influence of deficit irrigation schedules on nutrient uptake of maize hybrid under drip system. Journal of Pharmacognosy and Phytochemistry 2018. 7(4): 272-275.
9. Montemayor Y. J.A.; Gomez, A.O. M.; Olague, R. J.; Zermeno, A. G.; Ernesto, C.R.; Manuel, F. H.; Enrique, S.S.; Rogelio, A.N. Effect of three drip tape installation depths on water use efficiency and yield parameters in forage maize (*Zea Mays* L.) cultivation. Téc Pecu Méx, 2006. 44(3): 359-364.
10. Admasu, R.; Michael, A. W.; Hordofa, T. Effect of Moisture Stress on Maize (*Zea Mays* L.) Yield and Water Productivity. Int J Environ Sci Nat Res 2019. 16(4):83-87.
11. Karasu, A.; Kuscu, H.O.Z. M.; Bayram, G. The Effect of Different Irrigation Water Levels on Grain Yield, Yield Components and Some Quality Parameters of Silage Maize. Notulae Botanicae Horti Agrobotanici Cluj-Napoca 2015. 43(1), 138-145.
12. Payero, J.O.; Melvin, S.R.; Irmak S.; Tarkalson, D. Yield response of corn to deficit irrigation in a semi-arid climate. Agric. Water Manage 2006. 84:101-112.
13. Viswanatha, G.B.; Ramachandrappa, B.K.; Nanjappa, H.V. Soil-plant water status and yield of sweet corn (*Zea mays* L. cv. Saccharata) as influenced by drip irrigation and planting methods. Agric. Water Manage 2002. 55: 85-91.
14. Megyes, A.; Nagy, J.; Rátonyi, T.; Huzsvai, L. Irrigation of maize (*Zea mays* L.) in relation to fertilization in a long-term field experiment. Acta Agron. Hungaria 2005. 53 (1): 41-46
15. Meleha, M. I. Water management of maize crop on North Delta. J. Agric. Sci. Mansoura Univ., 2006. 31(2): 1185-1199
16. Abd El-Hafez S. A.; Meshref, H. A.; El-Hamdi, Kh. H.; El-Atawy, Gh.Sh.I. Effect of irrigation, nitrogen and organic fertilization on soil water relationships of *Zea maize* crop. J. Agric. Sci. Mansoura Univ., 2008. 33 (7): 5409-5418.
17. Abdel-Maksoud, H. H.; Ashry, M. R. K.; Youssef, K. M. R. Maize yield and water relations under different irrigation and plant density treatments. J. Agric. Sci. Mansoura Univ., 2008. 33 (5): 3881-3893.
18. Kara, T.; Biber, C. Irrigation frequencies and corn (*Zea mays* L.) yield relation in Northern Turkey. Pak. J. Sci., 2008. 11(1): 123-126.

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