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Research article

EFFECT OF DIFFERENT LEVELS ZINC SULFATE AND POTASSIUM SULFATE ON MORPHOLOGICAL CHARACTERISTICS CHARACTERISTICS OF SUNFLOWER (HELIANTNUS ANNUUS L.) UNDER WATER SALINITY

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ABSTRACT: To evaluate the effect of different doses of zinc sulphate and potassium sulphate on morphological characteristics of sunflower under saline conditions, an experiment was conducted as split plot in a randomized complete block design with three replications at the Agricultural Research Station of Zahak, located 20 km south of the Zabul city. In this experiment, the type of irrigation in two levels includes irrigation with salinity water (S) and irrigation with fresh water (N) were considered as the main treatments and zinc sulfate (ZnSO4) and potassium sulfate (K2SO4) were considered as as sub treatment. Morphological traits evaluated include plant height, head diameter, number of leaves. The results showed that a morphological trait in irrigation treatments in both normal and salinity mode was significant at the five percent level and performance was significant at the one percent level. Above traits due to fertilizer treatment was significant at the one percent level, Interaction of irrigation conditions and fertilizer are significant at the five percent level. Average comparison of traits in the interaction of fertilizer and irrigation conditions showed that all traits measured have maximum amount in the treatment of 60 kg zinc sulfate and 250 kg potassium sulphate in normal irrigation conditions (N-Zn3-K3).

Keywords: Sunflower (Helianthus annuus L.), zinc sulfate, potassium sulfate, salt stress

INTRODUCTION

Sunflower (Helianthus annuus L.) is an annual crop plant that is grown for oil extraction and is considered as one of the most important products to meet the country's need for oil. Sunflower is of active world's plants and during the short period of its growth, picked up the amount of soil nutrients. This value of harvest is influenced by many factors such as soil moisture, nutrient availability, and compared them with each other, weather conditions, type and number of expected performance. In evaluate the pattern of nutrient uptake by sunflower, researchers have found that the nutrient availability is critical in the developmental period. And damage that is caused by the limitations of one of them in some stages is not compensable. And 66% of nitrogen, phosphorus and calcium, 75% Potassium, and 90% Magnesium that is needed for sunflower absorbed during the flowering period (from the first stage of inflorescences to the final stages of flowering). Research has shown that zinc deficiency is effective on the activity of the hormone auxin in sunflower [1]. The most noticeable effects of zinc deficiency, are stunted growth and small leaves that are generally affected by the distribution of the hormone auxin metabolism particularly indole acetic acid distribution (IAA). In another study, the zinc concentration in plant tissue was noted at 25 to 150 mg per kg of dry matter, and explained that if this amount be less than 25 kg, Zn deficiency symptoms will appear, and in the concentration of more than 400 ppm is usually displayed the signs of poisoning. Sunflower is of plants that require high potassium [4]. Through during testing of fertilizer on oily and nuts sunflower in China found that to produce one ton of grain requires 166 kg of potassium (K_2O) and the mean nitrogen, phosphorus and potassium (N-P_2O_5-K_2O) absorption obtained 10-1-5. Potassium element for many essential reactions in plants, such as photosynthesis, assimilate translocation to the tank, Turgor maintain the plant enzyme activity and sodium ion uptake under salinity stress play a role [2].

Reports have shown that potassium deficiency caused by excess sodium may reduce the growth in millet crop [3]. Potassium sulfate fertilizer application will reduce the adverse effects of salt stress [5], and increases the aerial part of the plant, that these results have been confirmed by other researchers [2]. Potassium sulphate fertilizer use along with salinity stress increases the performance in many crops, in other words, potassium sulfate fertilizer will reduce the adverse effects of salinity on plants [2]. During the study, in the potassium-deficient sunflower, compared with sunflower with normal potassium value the sensitivity to the hormone abscisic acid and water use efficiency is lower [6]. With use of containing potash fertilizers, sunflower seed yield increased significantly and percentage of oil had the highest value in the split mode [7]. A group of researchers reported that consumption of potassium increased the salt tolerance and yield of sunflower. Potassium sulfate consumption also increases absorption of nitrogen and converting it into protein. Harmful effects of salinity in arid and semi-arid on crop plants is undeniable, areas with limited rainfall and high evaporation rate of the water shortage and lack of proper management of soil increases the salinity problems [3]. A group of researchers reported that consumption of fertilizers in the saline soils may increase or decrease its performance or even have no effect on it. In another study the effect of five levels of irrigation water salinity, 6/0, 3, 6, 9 and 12 (ds / m) on sunflower performance under greenhouse conditions - was examined. Results showed that increase in irrigation water salinity, decreases the sunflower seed performance [8]. Investigators investigate the effect of irrigation water quality, with six levels of salinity (control), 4/1, 2/3, 4, 6 and 8 (ds / m) on sunflower. Results of this research showed that, for every unit increase in salinity in values excess of 8/4 (ds / m), performance compared to control is reduced, that this is due to decrease in number of seeds per head, but the amount of seed oil to increase water salinity levels showed a partial response. Considering the Sistan region is located in hot and dry weather conditions, and soil salinity is a concern of many agricultural experts and farmers, and no research has been conducted independently, so, the present study was performed aimed to compare the effects of different doses of zinc sulfate and potassium sulphate fertilizers on yield and yield components of sunflower under saline and non-saline water, efficient use of water resources and area soil and reviews the sunflower plant salt tolerance and study the different interaction of zinc sulfate potassium fertilizers on sunflower yield under irrigation with non-saline water and saline water.

MATERIALS AND METHODS

In this study, as summer cultivation implemented in crop year 2012-2013 in Zahak Agricultural Research Station located 20 km south of the city of Zabol city. This area has a very dry climate with a long summer. The selected land, to run the tests in the previous crop year was under wheat cultivation. Physical and chemical properties of soil of this field are listed in Table 1. In this research, sunflower with community figure 1 with detailed features in Table 2 was used. This experiment was dominant as split plot in a randomized complete block with three replications. Irrigation treatments as a major factor in two levels: a) saline (S), b) non-saline water (N), and fertilizer of zinc sulfate ($ZnSO_4$) and potassium sulfate (K_2SO_4) as sub factors each at three levels included: zinc sulfate 0, 40 and 60 kg per hectare and potassium sulfate three levels of 0, 150 and 250 kg per hectare, respectively. Each experimental plot contains four lines of length 4 meters and distances between rows 50 cm, are cultivated with winter staiger agricultural machine cutter-rower for research experiments plots cultivation. In July and after wheat harvest (the previous product), land preparation operations including fight against weeds, plowing, two vertical discs, leveling and irrigation was done. After reaching the ground water conditions of field capacity the cultivation was done at 2012/8/2 with winter staiger agricultural machine cutter-rower. Based on soil test done at a depth of 0-30 cm, 200 kg of phosphorus were added to the ground before cultivation, and 270 kg nitrogen per hectare should be used that a third of urea fertilizer before planting, another third at 8-6 leaf stage and remaining a third was used in the budding stage. Harvest index was yellowing and color changes of the back of the head to brown.

Table 1: Analysis of elements in the Research Center of the Zahak city

Depth (cm)	**Conductivity**	**pH**	O.C%	Total N %	P (ppm)	K (ppm)	Fe (ppm)	Cu (ppm)	Zn (ppm)	Mn (ppn)	Soil texture	Sand %	Silt %	Clay %
0-30	3.7	8.1	0.27	-	24	38	3.1	0.79	0.6	6.6	Loamy	56	33	11

Table -2: Characteristics of sunflower cultivars used in the experiment

				The amount of Compounds in water (mEq/L)									
S.No	Sample Characteristics	The Electrical Conductivity	pH	Carbonate	Bicorbonate	Chloride	Calcium	Sodium	Total Cations	Carbonate	Bicorbonate	Sodium solution %	Sodium absorption ratio
1	Non-Saline water	870	2.8	0	2.5	3.9	3.3	5.6	8.8	61	1.4	1	
2	Salt water (Wells)	6430	7.8	0	8.3	31.6	15.8	49.9	65.7	76	17.8	2	

RESULTS AND DISCUSSION

Results and Discussion about the agronomic traits in sunflower:

The results of analysis of variance for morphological traits in sunflower under irrigation conditions affected by fertilizer:

(Table 3) shows that plant height, head diameter, number of leaves per treatment, traits in irrigation treatmentis significant at the five percent probability level and performance is significant at the one percent probability level. Above characteristics due to fertilizer treatment is significant at the one percent probability level, but in the interaction of irrigation conditions and fertilizer are significant at five percent probability level.

Table-3: Analysis of variance for morphology traits of sunflower under irrigation conditions affected by fertilizer

Traits Sources of variation	**Freedom degree**	**Plant height**	**Head diameter**	**Number of leaves**
Repeat	**2**	**42.821** ^{ns}	**1.154** ^{ns}	**2.167** ^{ns}
Irrigation Conditions	**1**	**549.382** *	**13.500** *	**0.167** *
Error	**2**	**36.021**	**1.654**	**9.722**
Fertilizer	**8**	**214.833** **	**2.850** **	**5.375** **
Interaction	**8**	**12.948** *	**0.461** *	**1.542** *
Error	**32**	**34.059** *	**0.493**	**0.799**
Coefficient of variation (percent)	**-**	**%6.02**	**%7.93**	**%9.19**

** Significant at 1% probability level, significant at the probability level of 5%, ns no significant difference

Table 4: Comparison of the average agronomic traits in sunflower under normal condition and water salinity

Traits treatment	Plant height(cm)	Head diameter	Number of leaves
normal	100.1 a	9.4 a	9.8 a
Salinity	93.8 b	8.4 b	9.7 a

Average comparison of morphology traits in sunflower in irrigation conditions:

Table 4 shows that plant height (100.1 cm), head diameter (9.4 cm) and maximum number of leaves (9.8) are maximum at the normal Irrigation conditions and are in top class (Figures 1 to 5).

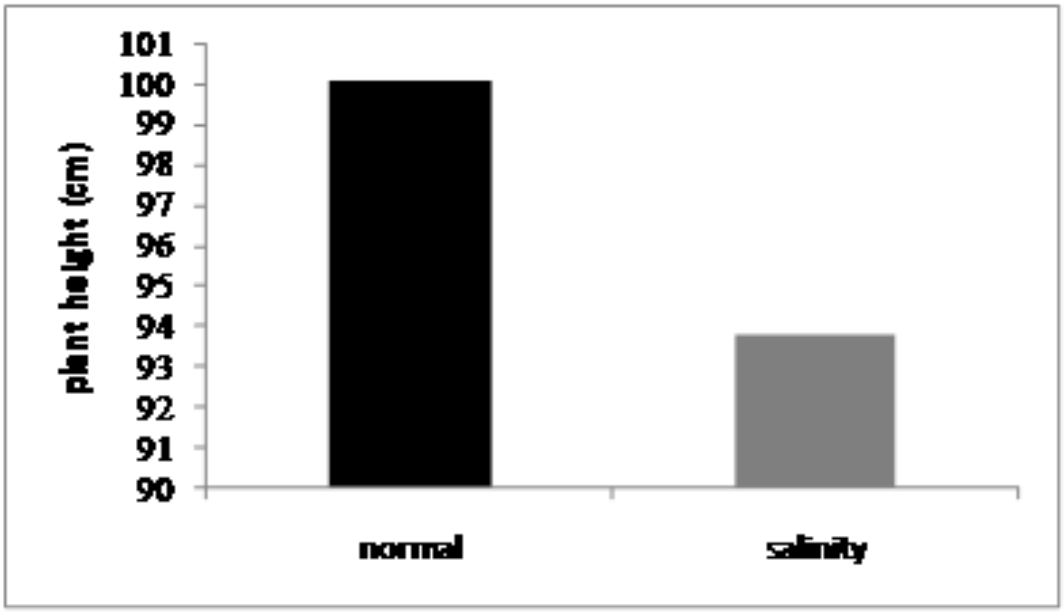

Figure-1, **Plant height under irrigation condition**

According to the chart above, the number of height under normal irrigation condition has been reached to 100.1cm and at terms of use of salt water the number height has been reached to 93.8cm.

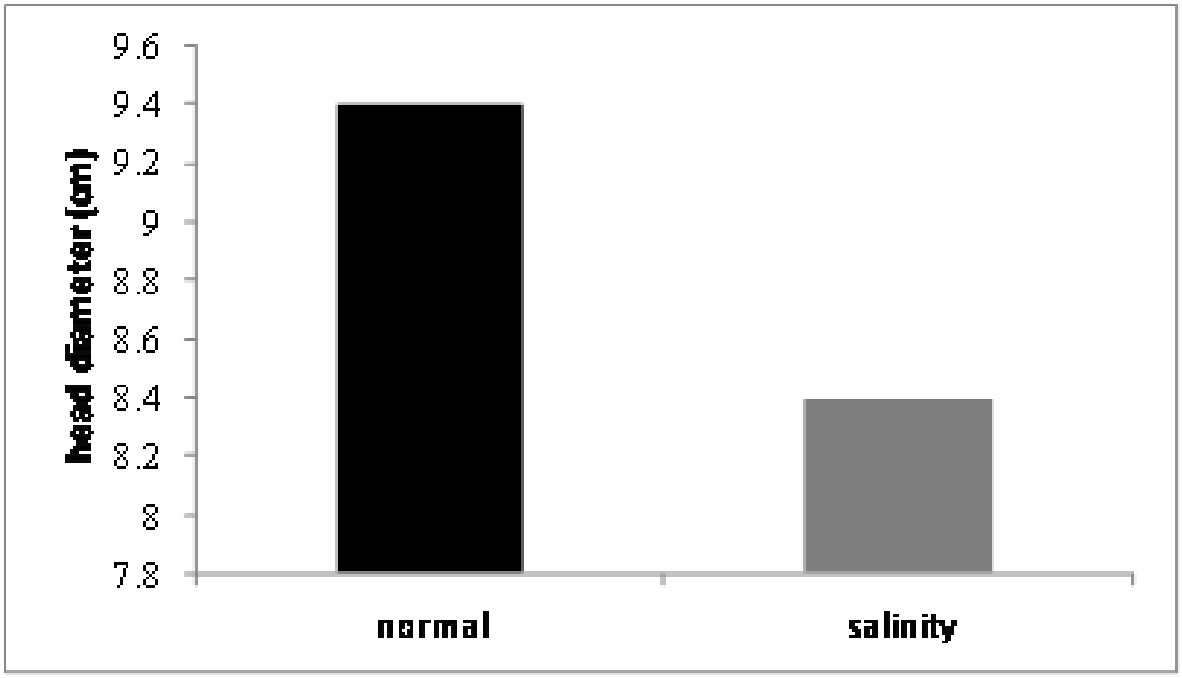

Figure-2: Head diameter under irrigation Condition

According to the above chart, head diameter under normal irrigation condition was 9.4 cm and in the irrigation with saline water was 8.4 cm.

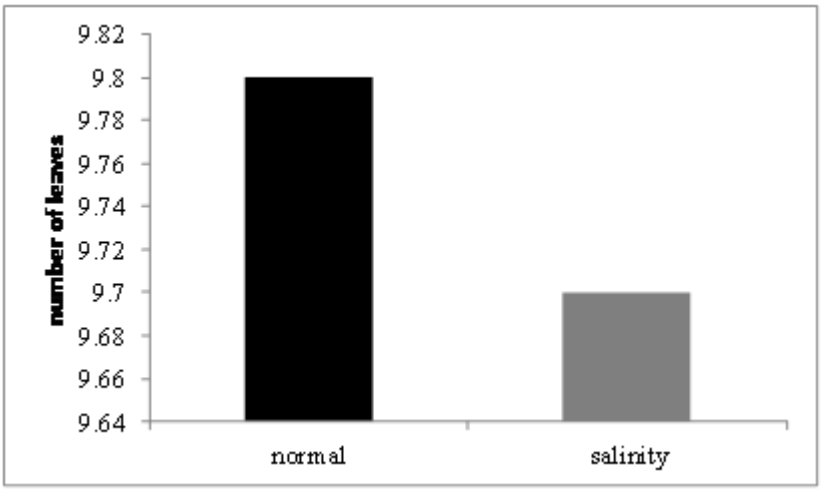

Figure-3: Number of leaves under irrigation condition

According to figure 3 number of leaves under normal conditions is 9.8 numbers, whereas in salinity conditions are 9.7 numbers.

Table 5: Comparison of the average sunflower morphology traits affected by zinc and potash fertilizer

Traits Fertilizer	Plant height(cm)	Head diameter (cm)	Number of leaves (number)
Zn0k0	93.2 bc	8.2 d	9.3 bc
Zn0k1	92 c	8.3 cd	9.2 bc
Zn0k2	91.8 c	8.6 cd	9.5 bc
Zn1k0	95.9 bc	8.6 cd	8.7 c
Zn1k1	93.2 bc	8.7 bcd	9 c
Zn1k2	94.7 bc	8.4 cd	9.3 bc
Zn2k0	98.3 b	9.1 bc	10 b
Zn2k1	105.9 a	9.4 b	11 a
Zn2k2	107.8 a	10.4 a	11.5 a

Average comparison of agronomic traits in sunflower under effect of Fertilizer: (Table 4) shows that maximum plant height (107.8 cm), head diameter (10.4 cm) and maximum number of leaves (11.5 numbers) at treatment zn2k2 (zinc 60 kg and 250 kilograms of potassium per hectare) have highest value and relative to the other treatments have shown superiority (Figures 4-6).

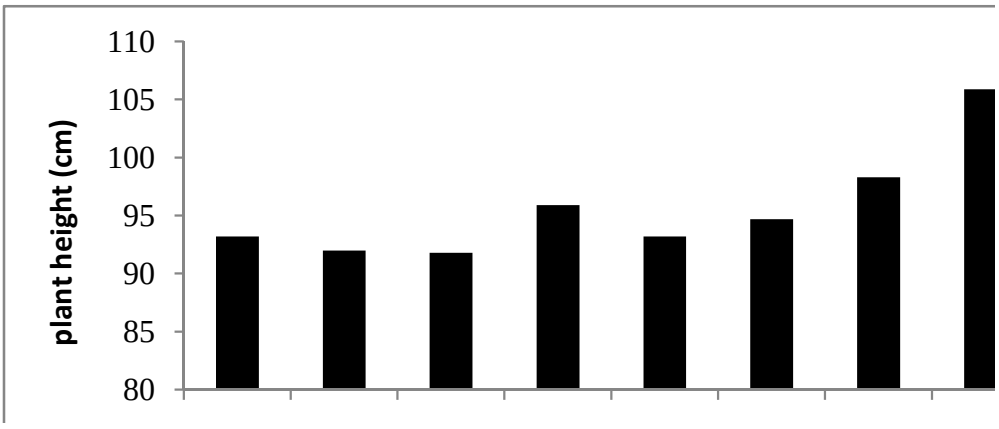

Figure-4: Plant height affected by fertilizer

According to the figure-4 under (zn2k2) the use of zinc sulfate fertilizer 60 kg and 250 kg potassium sulfate, plant height, maximum height (107.8 cm) is reached. Potassium sulfate fertilizer application reduces the adverse effects of salinity [5] and increases the height of the plant. In this regard, other investigators have reported similar results.

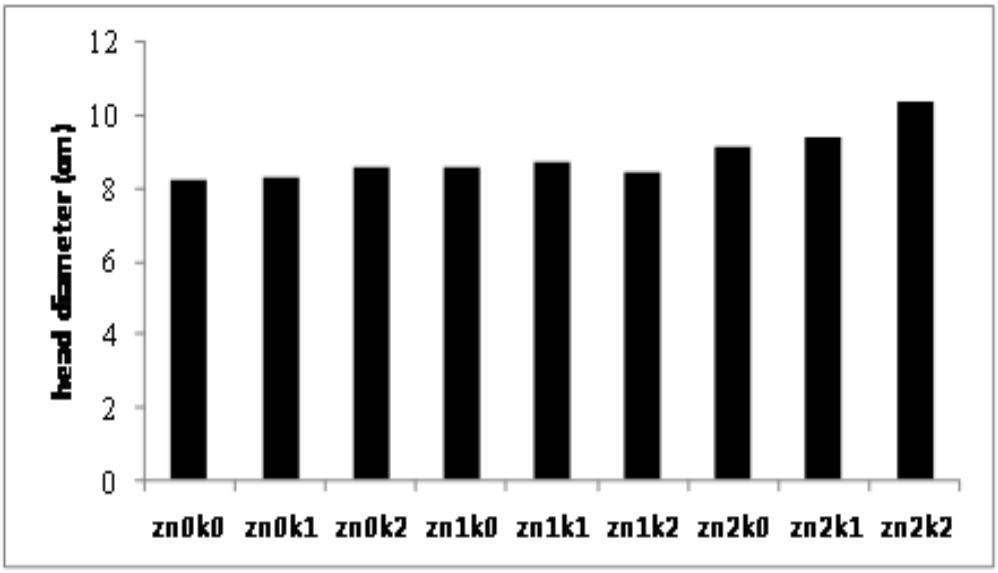

Figure-5: Head diameter affected by fertilizer

According o the chart above under (zn2k2) the use of zinc sulfate fertilizer 60 kg and 250 kg potassium sulfate, its maximum diameter, it 10.4 cm is reached.

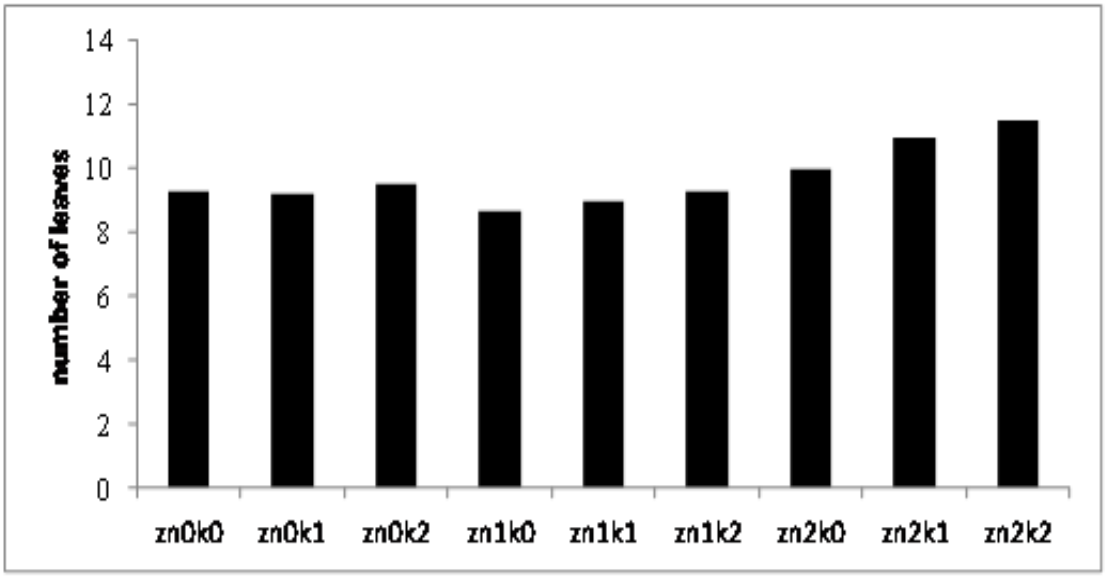

Figure-6: Number of leaves of fertilizer

As can be seen in the chart above under (zn2k2) number of sheets to 11.5 number is reached.

Average comparison of morphological traits in sunflower in the interaction of irrigation conditions and fertilizer: (Table.4) shows that the maximum plant height (113.2 cm), head diameter (11.4 cm) and number of leaves (11.7 number) at treatment Nzn_2k_2 (zinc 60 kg and 250 kilograms of potassium per hectare in normal irrigation condition) have highest value and is located in the premier class Figures7-9.

Table -4: Comparison of the average sunflower morphology traits in interaction of irrigation conditions and zinc and potash fertilizers

Traits Interaction	Plant height(cm)	Head diameter	Number of leaves
NZn0k0	96.8 cd	8.8 cd	8.7 de
NZn0k1	94.8 cd	8.6 cd	9.7 bc
NZn0k2	93.1 cd	8.9 cd	10 abc
NZn1k0	97.4 cd	9 bc	9.3 cd
NZn1k1	96.5 cd	9.3 bc	9 cd
NZn1k2	97.8 cd	9 bc	9 cd
NZn2k0	100.4 cd	9/1 bc	9.3 cd
NZn2k1	111.3 ab	10.2 ab	11.3 ab
NZn2k2	113.2 a	11.4 a	11.7 a
SZn0k0	89.6 d	7.6 e	10 abc
SZn0k1	89.1 d	8.1 cd	8.7 de
SZn0k2	90.4 d	8.3 cd	9 cd
SZn1k0	84.3 cd	8.2 cd	8 de
SZn1k1	89.8d	8.1 cd	9 cd
SZn1k2	91.5 cd	7.9 e	9.7 bc
SZn2k0	96.2 cd	9 bc	10.7 abc
SZn2k1	100.5 cd	8.5 cd	10.7 abc
SZn2k2	102.4 bc	9.5 bc	11.3 ab

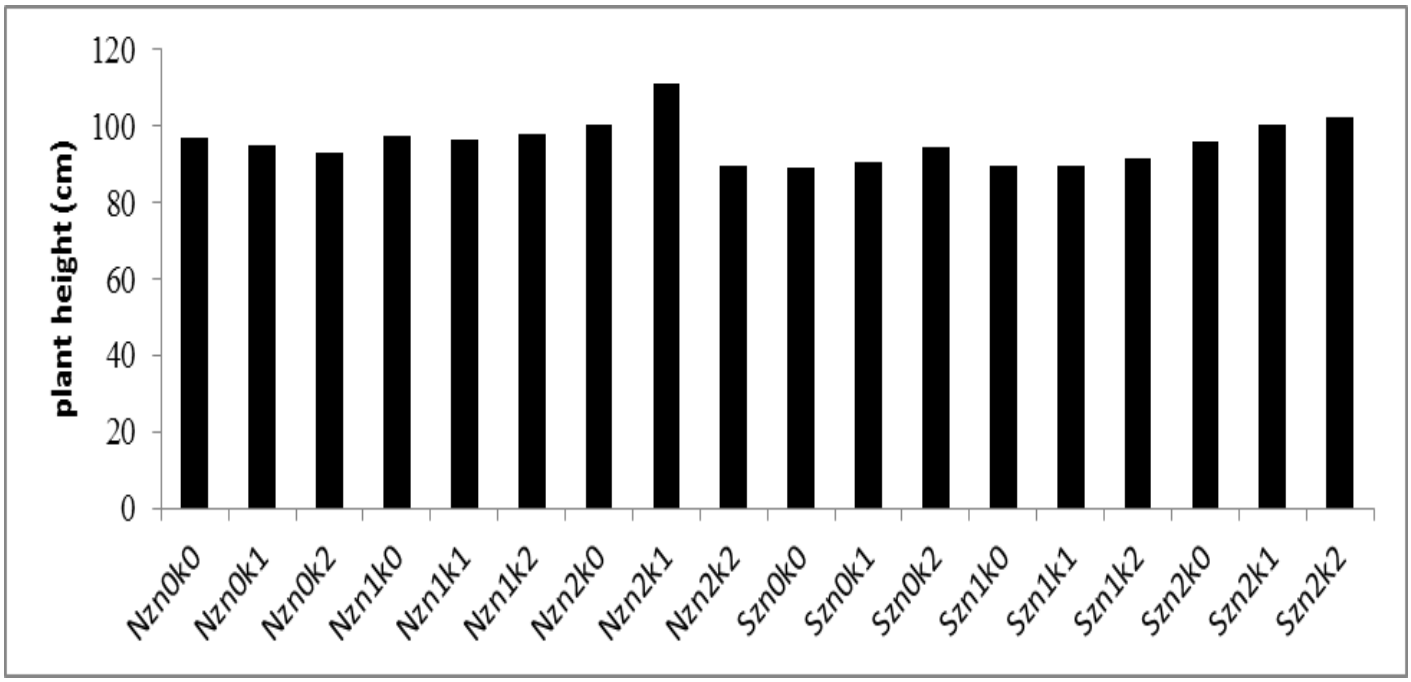

Figure-7: Plant height in terms of interaction of irrigation conditions and fertilizer

According to the diagram (4.7) in terms of ((NZn2k2 mean normal irrigation and use of 60 kg zinc sulfate fertilizer and 250 kg potassium sulfate fertilizer per hectare, the maximum hight is reached to 13.2 cm, irrigation with saline water and use of 60 kg zinc sulphate fertilizer and 150 kg potassium sulfate fertilizer per hectare, the maximum plant height has been reached to the 102.4 number.

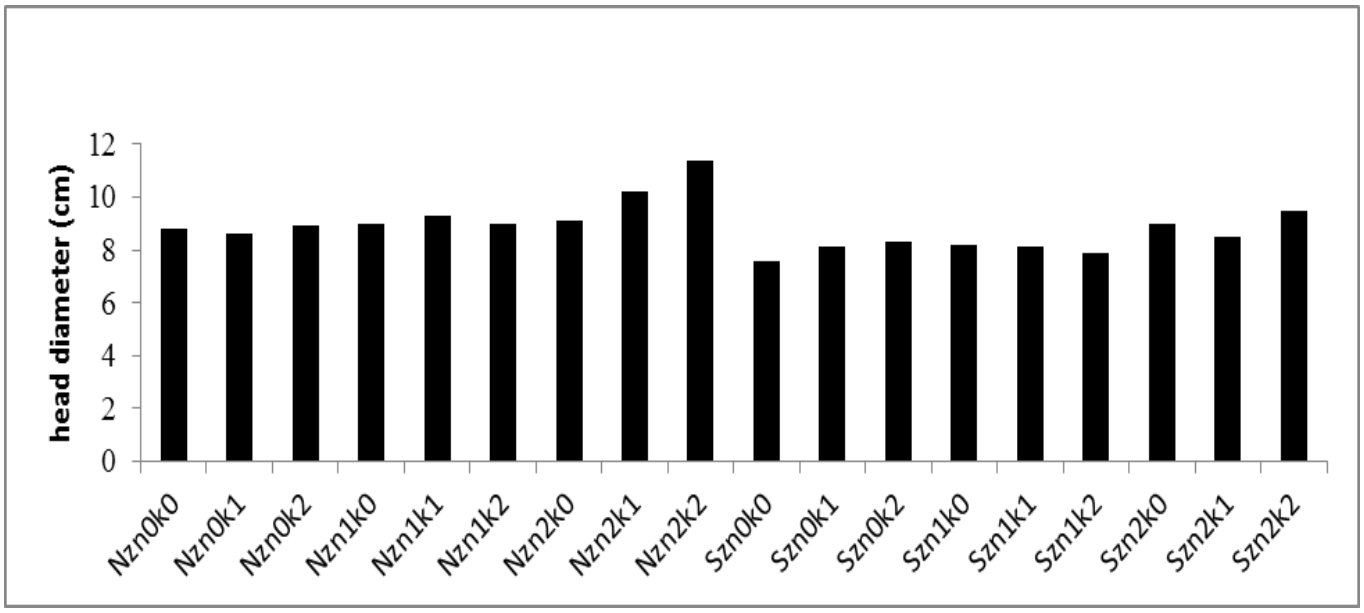

Figure-8: Head diameter in the interaction of irrigation conditions and fertilizer

According to the figure.8 in terms of ((NZn2k2 mean normal irrigation and use of 60 kg zinc sulfate fertilizer and 250 kg potassium sulfate fertilizer per hectare, the maximum head diameter is reached to11.4 cm, whereas in (SZn2k2) mean irrigation with saline water and use of 60 kg zinc sulphate fertilizer and 250 kg potassium sulfate fertilizer per hectare, maximum head diameter has reached to 9.5 cm.

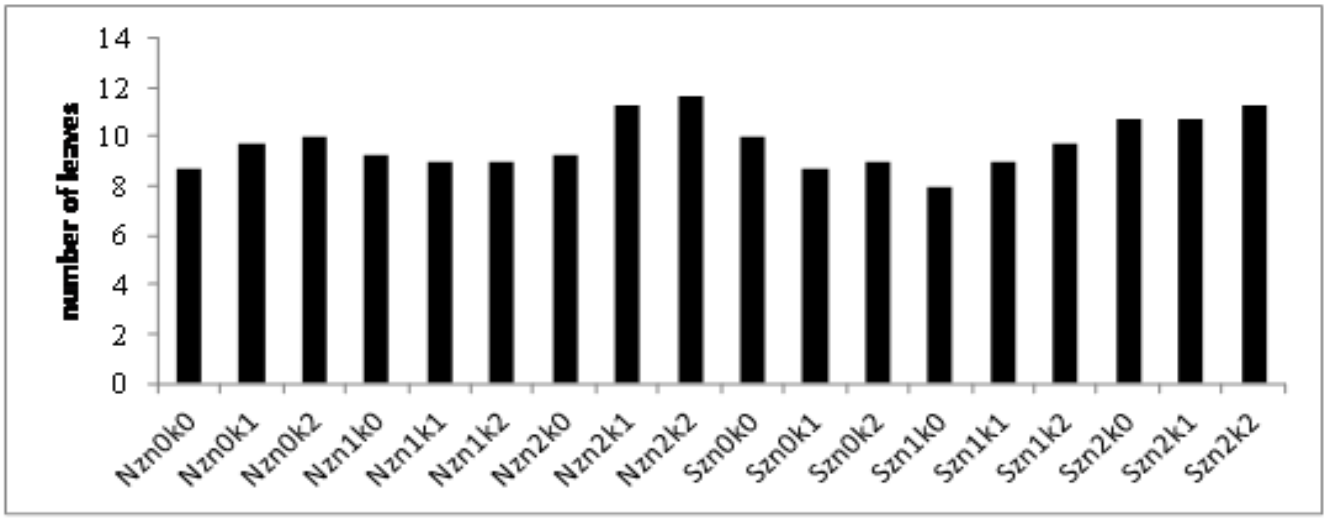

Figure-9: Number of levels in the interaction of irrigation conditions and fertilizer

According to the figure.9 in terms of (NZn2k2) mean normal irrigation and use of 60 kg zinc sulfate fertilizer and 250 kg potassium sulfate fertilizer per hectare, the maximum number of leaves of sunflower is reached to 11.7 number, whereas in (SZn2k2) mean irrigation with saline water and use of 60 kg zinc sulphate fertilizer and 250 kg potassium sulfate fertilizer per hectare, the maximum number of leaves of sunflower is reached to 11.3 number.

CONCLUSIONS

The results of analysis of variance for morphological traits of sunflower(plant height, head diameter, number of leaves) were affected by irrigation type and be significant at the probability level of five percent and one percent. The result is that the irrigation water salinities by effect on vegetative growth stages affected the reproductive growth stage of the plant and reduce yield components.

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