The effect of fertilizers and quality of irrigation waters on qualitative and quantitative characteristics of wheat in Kerman provine, Iran

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Abstract

Water used for irrigation can vary greatly in quality depending upon type and quantity of dissolved salts. Salts are present in irrigation water in relatively small but significant amounts.the study were conducted to evaluate the effect of quality of irrigation water and different levels of the main nutrient on quantitative and qualitative characteristics of wheat plateau , a plan with 3 separate experiments as split plot in three replications. The plan with three salinity levels (w_1=2.28, w_2=5.5, w_3=9 dSm^{-1}) and 9 fertilizer treatments included four levels of nitrogen (0, 70, 100 and 130 kg per ha), phosphorus levels (0, 30 and 50 $kg.ha^{-1}$) and potassium levels (0 and 50 $kg.ha^{-1}$) were studied in mohamadabad farm in kerman orzoyie. in the studing of effect of each element ,two other elements were used in recommended amount based on soil test. in this project 5 times irrigation and after the harvest, yield, 1000 grain's weight and the percentage of protein in different treatments were determined. the Studing of results show that the average yield in w_1 is higher than w_2 and this treatment is more than w_3 and also effects of different levels of nitrogen fertilizer and three levels of irrigation water on yield at 1% level have significant differences. The yield difference with work of three phosphorus treatment and various quality of water have been significant at 1% level and with increasing salinity and using phosphorus fertilizer the yield will be reduced. the yield of water's treatments in 1% level showed significant differences , but fertilizers treatment's yield are not significant. Generally for tap water, w_1 formula fertilizer (0-30-70), for salty water , w_2 (0-30-70) and salt water w_3 (50-30-70) kg pure element is proposed in each hectares that amount of nitrogen is less than recommendations amount based on soil tests, phosphorus is equal with considered amount based on soil test and for potassium for the waters w_1 and w_2 is equal and w_3 is more than the recommended amount.
Results of analysis 1000 grains weight and percentage of protein show that different levels of nitrogen with high quality irrigation waters have the most effect on weight of 1000 grains and protein rather than other fertilizer levels. Overall for the optimum use of water resources and saline soils, special management, correct fertilization and research

projects in the field of land reform (especially washing before planting) should performed.

Introduction

The major part of iran's area have semi-arid and arid climate that they have little rainfall and high evaporation and ultimately these factors lead to salt accumulation in soil.
In these areas a huge part of soils are faced with limitations of salinity that irrigating these lands with poor quality waters can be aggravated problem. But in any case such resources (saline soils) in these areas are considered as a common job that finding a suitable solution for optimum use of these resources is important. For saline water a special management should be applied and use of fertilizers need to attention and observe aspects of precautions. In these circumstances with selecting plant's model, resistant plants to salinity should be considered.[2,5]
Special conditions of the province of Kerman have tensed the salinity problem, which it makes water use and soil the error. orzoyie plains are one of the important areas for crop cultivation that deficit precipitation, severe evaporation and indiscriminate withdrawal of ground water table makes water quality poor in recent years. Evaluating and comparing results of zone water's analysis shows that the intensity of salinity waters is increased in 1998 but in consumption agricultural inputs (especially chemical fertilizers) and irrigation management we have no changes so for studying the potions of chemical fertilizers consumption (nitrogen, potassium and phosphorus) in different conditions of salinity of irrigation waters this project is accomplished in orzoyie plain.
Studies of Gopta (1990) show that the different plants tolerance of salinity is different and the amount of a particular plant tolerance of salinity at different stages is different. Also salinity is effective on growth and yield of plants thorough increasing osmotic pressure and concentration of specific ions.[10]
Studies of Frakoys(1989) that is done on sugar beet, wheat, barley and tomato shows that sugar beet in germination stage and wheat, barley and tomatoes in the next stage of germination are sensitive to salinity.[9]
Studies showed the in salinity of saturation extract 12-16 ,16-24, 24-16 and 7.5 dSm^{-1} respectively, sugar beet, wheat, barley and tomato 50% of their seeds is budding.[4]
 Researches of Farida (1996) distinguished that effects of irrigation water's salinity are different.when salinity is more than 1 dS/m unfavorable effects on seed germination starts so in these cases special management should be applied. some adverse effects of salinity are spots in the field, delayed growth, inadequate size of plants and bluish green leaves.[6] Also, studies on the germination and growth of wheat in saline soils shows that leaching before planting and apply special management, in the use of saline waters can reduced a considerable percentage of damage due to salinity. Since now many studies about using of saline waters is accomplished.[3]
Studies indicate that irrigating cotton with sprinkler system with salinity of 5 dS/m is possible that symptoms of burning on the sidelines of leaves are seen, but it has no effect on yield reduction.[2]

The purpose of this research is examine into water's salinity effects on yield, protein percentage and 1000 grains weight of plateau wheat in one of the main family of orzoyie soil and determining fertilizer formula for the main elements in waters with different salinity.

Materials and Methods

With due attention to orzoyie Plain in kerman province is the most important region for crop cultivation (especially wheat) that are encountered whit the problem of irrigation water quality. Therefore, this project was carried out in the mohamad abad field in orzoyie. Figure1, shows the study area in Kerman province and Iran.
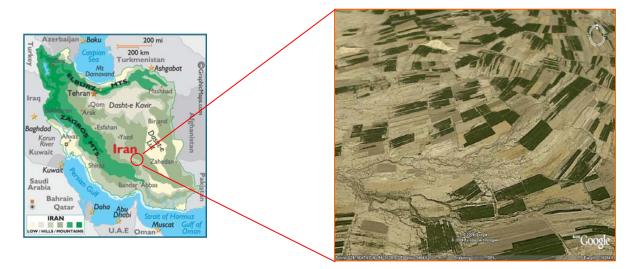

Fig. 1. Location of the study area

Plan includes three experiments with different treatments of nitrogen, phosphorus and potassium, and three quality of irrigation water which is conducted on plateau wheat. This plan in three separate point with three salinity levels (9 and 5.5 and 2.28 dSm^{-1}) and 9 fertilizer treatments (recommended based on soil test), including four levels of nitrogen (0,70,100 and 130 kg per ha), three levels of phosphorus (0, 30 and 50 kg per ha) and two levels of potassium (0 and 50 kg per ha) respectively from Ammonium sulfate, triple super phosphate , potassium sulfate with three replicate in 2 m square plots was conducted as split plot.

Table 1. soil's physical and chemical characteristics in experiment's area

Texture	SAR	$Ca^{2+}+Mg^{2+}$ (meq.lit^{-1})	Na^+ (meq.lit^{-1})	K_{ava} (mg.kg^{-1})	P_{ava} (mg.kg^{-1})	OC (%)	TNV (%)	pH	ECe (dSm^{-1})	Soil Depth (cm)
Silty Loam	15.1	106	110	222	12	0.5	28.7	8.3	19.9	0-30

In studying of each elements effect , two others elements were used in recommended amount based on soil test. Phosphor and potassium and 1/4 of nitrogen fertilizers were distributed uniformly in plots before planting and other Nitrogen fertilizers were used on three occasions.

Table 2. Applying water's chemical characteristic in study area

SAR	K^+	Ca^{2+}	Na^+	$Ca^{2+}+Mg^{2+}$	SO_4^{2-}	HCO_3^-	Cl^-	pH	ECe (dSm^{-1})	Location of motor pomp's water
				meq.lit^{-1}						
6.84	-	-	16.2	11.2	9.3	4.2	13.6	7.5	2.28	rural
9.87	-	-	39.5	32	29.3	4.8	36.2	7.5	5.5	research station's water
9.4	-	-	53.6	65	92	8.4	18	7.2	9	Mohammad Abad

Experimental plots with mentioned three irrigation water quality in the first place of tap water (research station's water), second place brackish water (rural motor pomp's water) and third place saline water (mohamadabad motor pomp's water) that water locations 1 and 2 were carried by Tanker and plan irrigated 5 times. Before the plans implementation, soil samples were prepared from field and analyzed. Also the sample of water consumed was prepared and analyzed and in each turn of irrigation the water salinity was determined. After harvesting wheat, yield, weight of 1000 grains and protein's percentage in different treatments were determined and analyzed.

Results and discussion

Overall, the studying of results indicate that the average yield (for all levels of fertilizer consumption) in W_1 treatment is more than W_2 and also the average yield in this treatment (W_2) is more than W_3 treatments. The results of yield's variance analysis with consumption 4 levels nitrogen (N_1, N_2, N_3, N_4) and three levels of irrigation water (W_1, W_2, W_3) showed that the effects of consumption different levels of Nitrogen fertilizer on yield had significant difference at 1% level statistically and also three qualities of irrigation water were caused a significant difference on yield at 1% level. The results of comparing interaction effects mean between nitrogen fertilizer and irrigation water quality showed that the yield's mean (W_1N_2) with the amount of 4100 kg per ha have had the highest yield and with increase and non-use of nitrogen and water salinity ,yield mean will decrease significantly , so that the yield's mean (W_3N_4) and (W_3N_1), respectively 1890 and 1760 kg per ha are lower than other treatments. So for

three water samples used (W_1, W_2, W_3) 70 kg per ha of nitrogen is recommended that is less than the recommended amount based on soil test.

Table 3. comparison the average of different amount of nitrogen consumption's effect in wheat yield in different levels water's salinity

water's salinity (dSm^{-1})					nitrogen consumption (Kg.ha^{-1})
11<ECw	8.8>ECw<11	6.4 > ECw <8.7	4.1 > ECw <6.3	ECw = 4	
1376c	1580c	1760c	2027c	2833c	0
1945a	2100a	2407a	2757a	4100a	70
1743b	1970b	2110b	2383b	3600b	100
1458bc	1674b	1890bc	2240bc	3423b	130
1630B	1831B	2042C	2352B	3487A	average

Table 4. comparison the average of different amount of nitrogen consumption's effect in biologic yield of wheat in different levels of water's salinity

water's salinity (dSm^{-1})					nitrogen consumption (Kg.ha^{-1})
11<ECw	8.8>ECw<11	6.4 > ECw <8.7	4.1 > ECw <6.3	ECw = 4	
3190c	3577c	4100c	4702c	5933c	0
4573a	4987a	5234a	5647a	8475a	70
4067b	4440b	4600b	4815b	7150b	100
3800bc	4065bc	4357bc	4715bc	7148b	130
3900B	4267C	4573C	2352B	7177A	average

From analysis of variance can be concluded that performance differences by applying three phosphor fertilizer treatments (P_1, P_2, P_3) is significant at 1% level. These results also indicate that performance differences of different water qualities (W_1, W_2, W_3) is significant at 1% level statistically. On the other hand applying different phosphor treatments and irrigation water have interaction effect on yield that can be seen at 1% level statistically. Comparison results indicate that the yield's mean with using three different levels of irrigation water quality are treated in three groups and differences between them are significant so that the yield (W_1P_2) is the highest (3590 kg per ha) and with increasing electrical conductivity of water (W_2, W_3) yield decreased significantly, so that the treatments yield mean (W_3) is lowest (about 2040 kg ha^{-1}).

Table 5. comparison the average of different amount of phosphor consumption's effect in wheat yield in different levels water's salinity

water's salinity (dSm^{-1})					phosphor consumption (Kg.ha^{-1})
11<ECw	8.8>ECw<11	6.4 > ECw <8.7	4.1 > ECw <6.3	ECw = 4	
1875c	1904c	2033a	2210b	2567b	0
1673b	1874c	2083a	2633a	3590a	30
1452b	1680b	2040a	2600ab	3543a	50
1670B	1832C	2052A	2481B	3233A	average

Accuracy in comparison with results of operations will be determined by increasing electrical conductivity of irrigation water and consumption of phosphor fertilizer the yield will be decreased so that yields mean of consumption three levels of phosphor fertilizer (P_2, P_1, P_3) in the saline irrigation water (W_3) have no significant difference it means in irrigation water (W_3) use or non-use of fertilizer has no effect on yield.

Table 6. comparison the average of different amount of potassium consumption's effect in wheat yield in different levels water's salinity

water's salinity (dSm^{-1})					potassium consumption (Kg.ha^{-1})
11<ECw	8.8>ECw<11	6.4 > ECw <8.7	4.1 > ECw <6.3	ECw = 4	
1875c	1930b	2033a	2170a	3060a	0
1673b	2240a	2083a	2180a	2940a	50
1774C	2085B	2058B	2175B	3000A	average

Tables of analysis of variance indicated treatments yield's differences (W_1, W_2, W_3) with potassium levels are significant at 1% level statistically , but yield of treatments (K_1) and (K_2) is not significant. Also consumption of potassium fertilizer and irrigation water quality in 1% level indicated interaction effect on yield. In general we can say that in waters (W_1) and (W_2) level (K_1 – non-use of potassium fertilizer) and for water (W_3) treatment (K_2 - consumption 50 kg potassium per ha) recommended that for normal waters and brackish water is equal with recommended amount based on soil test and for saline water is more than the recommended amount. the results of variance analysis showed that if the weight of 1000grains were in all three experiments in three water treatments (w_1,w_2,w_3)irrigations have significant difference at 1% level. in the used fertilizers treatments the effects of treatments on 1000 grains weight is which applying four nitrogen levels (N_1, N_2, N_3, N_4) at the 1% level show significant effect on 1000 grains weight but this effect about 3 levels of phosphorus fertilizer (P_2, P_1, P_3 is significant at 5% level and in using of the potassium fertilizer (K_1, K_2) a significant difference between 1000 grains weight is not seen. In addition, in all three experiment

between different fertilizer treatments and irrigation water , the results of variance analysis of protein of consisting samples of wheat indicate that generally , in different waters (W_1, W_2, W_3) the applying nitrogen treatments have highest protein percentage rather than phosphorus and potassium(the highest protein nitrogen treatments (W_1N_1) 14.88%, phosphorus (W_3P_3) 14.63% and potassium 14.65%,)also in normal waters the amount of protein in(W_1N_4) 14.88%) treatment is higher than other treatments.

Conclusion

Overall, the studies show that there are too differences between the recommended fertilizer formulas that obtained with the amount of consuming fertilizer farms. Consumption of fertilizer in various fields with different salinity and alkalinity and physical characteristics is almost the same. In case the needs of different products to fertilizer are different in soil.

This study was done in a (Coarse loamy, mixed, hyperthermic, Typic Torrifluvents) soil and for tap water (W_1) fertilizer formula (0-30-70), for brackish water (W_2) (0-30-70) and for salt water (W_3) (50-30-70) kg pure element per ha is obtained.

According to research conducted in this area the following is recommended:
• Study of soil salinity location plans (EC=19.9 dSm^{-1}) and other samples of analyzed soil from the farms shows that soil salinity is high so for reducing the damages of salinity and more products in area of projects about Land reform, especially washing the soil before planting is recommended [5]
 • With due attention to the process of plain water salinity a complete study about the quality and speed of damages should be done.
• Cropping pattern in the fields should be selected based on soil characteristics and water quality.
• Consumption of chemical fertilizers must be conducted based on plants needs and the results of research projects.
. For saline water special management should be applied and intercept indiscriminate using of fertilizers.

References

1. Basiri, A. 1993. statistical plans in agriculture's science , shiraz university publication , fifth edition.

2. Haghnia, G. 1996. plants tolorence for salinity(translate) , mashad university jahad publication

3. Samadi, H. 2001. studying the effect of waters chemical combination on absorption and transmission elements in two genotype of pistachio sapling and their growth. Ph.D dissertation in soil science, agriculture faculty of Tehran university . 300pp.

4. Alizadeh, A. 1984. waters quality in irrigation (translation) Astan Ghodse Razavi publication. third edition. 93pp.

5. National committee of irrigation iran 2003 using saline and brackish water for irrigating number 26 magazine.

6. Ayers, R.S. and D.W Westcot , D.W.1985. Water quality for Agriculture, FAO. Irrigation and Drainage paper No. 7. Rome .

7. FAO/UNESCO .1973. Irrigation, drainage and salinity. An international source book. No 113.

8. Farida, B .1996. A comparative study of the effect of NaCl salinity on germination of wheat and triticale, Bangladesh J. of sci. And ind, Res 31: 43-51.

9. Fracois, L. E; T. Donovan; K. Lorenz and E.V.Maas .1989. Salinity effects on grain yield, quality, vegetative growth and emergence Agron,J,81: 707-712.

10. Gupta, I.C .1990. Use of saline water in Agriculture, A study of arid and semiarid zones of India , Revised edition oxford & IBH publishing co, PVT,LTD.