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Evaluation Impact of Different Irrigation Regime and Nitrogen Fertilizer on Qualitative Characteristics of Wheat

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ABSTRACT

BACKGROUND: One of limitation factor in agricultural plants production in dry areas, supply requires water. Also nutrition crop management is a necessary strategy for achieve sustainable agriculture.

OBJECTIVES: Current study was conducted to assessment the effects of different irrigation regimes and several amount of nitrogen fertilizer on seed nutrition content and qualitative trait of wheat.

METHODS: This research was done via factorial experiment based on completely randomized design with three replications. The factors consisted different irrigation regime (I_1=half of water demand, I_2= equal of water demand and I_3=1.5 water demand) and nitrogen fertilizer (N_1=nonuse of nitrogen or control, N_2=50%, N_3=75% and N_4=100% according soil test).

RESULT: According result of analysis of variance effect of different level of nitrogen fertilizer, irrigation regime and interaction effect of treatments on all measured traits (instead phosphorus concentration) was significant at 1% probability level. Mean comparison result of different level of irrigation regime indicated that maximum nitrogen concentration was noted for half of water demand and minimum of that belonged to 1.5 water demand treatment, so increasing the volume of consumed water led to decrease the seed nitrogen concentration from 1.73 $mg.kg^{-1}$ to 1.49 $mg.kg^{-1}$. Nitrogen fertilizer increased nitrogen content from 1.2 in control to 2 $mg.kg^{-1}$ in 100% according soil test treatment but does not have significant effect on phosphorus content also led to increase potassium content.

CONCLUSION: Comparison of different irrigation treatments showed that increasing the volume of water decreased seed nitrogen content, increase potassium content and don't have significant effect on phosphorus content. Also increasing consumed water led to decreased ease seed protein content. The maximum protein concentration (15%) was noted for half of water demand and 100% according soil test.

KEYWORDS: *Deficit irrigation, Nutrition, Phosphorus, Potassium, Protein.*

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1. BACKGROUND

Crop production during the spring and summer months in the semi arid Mediterranean type the environments mainly relies on irrigation (Sepaskhah and Khajehabdollahi, 2005). One of limitation factor in agricultural plants production in dry areas in the water tension at growth step negative effect of water tension on corn growth depends on the time of tension occurrence, the intensity, plant growth and genotype step. Low irrigation in one of strategies to expert agricultural plant tillage and scrounge in water use which is a proper method to produce harvest in water shortage, generally in this method water performance is reduced cognizant to be compensated by enter tillage surface expansion and in many areas of America, India, Africa and many other lands which have water shortage, this method is prevalent (English and James, 1990). The limitation of water resources in arid and semi-arid areas was the main reason that we considered water as the most important material in the production lines, although people often do not obey the irrigation water consumption rules and regulations (Cakir, 2004). Innovations for saving water in irrigated agriculture and thereby improving water use efficiency are of paramount importance in water-scarce regions. Conventional deficit irrigation is one approach that can reduce water use without causing significant yield reduction (Kirda *et al*., 2005). Nutrient management is one of the most important factors that affect the growth and yield of maize (Verma, 2011). Crops require food elements to grow and produce. These elements are available to plants through soil and fertilizers. Management of the use of chemical fertilizers, especially nitrogen, is one of the most common and the most popular for crop research, because the deficiency and exacerbation of this element are both harmful (Murdock *et al*., 1997). Fertilizer management plays an important role for obtaining satisfactory yields and to increase crop productivity. Nutrient management may be achieved by the involvement of organic sources, bio fertilizers, and micronutrients (Singh *et al*., 2002). Nitrogen fertilizer is a key nutrient in the production of non-legume crops. It is a component in many biological compounds that plays a major role in photosynthetic activity and crop yield capacity (Cathcart and Swanton, 2003) and its deficiency constitutes one of the major yield limiting factors for cereal production (Shah *et al*., 2003). Nitrogen is the most limiting essential nutrient for maize production (Aftab *et al*., 2007). Nitrogen has positive effect on storage of protein in Maize seed and hence, the rates of this element are effective in its distribution in plant (Souza *et al*., 1998). A low nitrogen content in the soil leads to poor absorption of micronutrients by plants, which may be insufficient for the complete development of the plant tissue (Szulc, 2013). So an excessive accumulation of mineral nitrogen in the soil poses a risk of water pollution as a result of nitrate leaching by precipitation (Ladha *et al*., 2005). The impact of increased fertilizer use on crop production has been large and important (Hossain and Singh, 2000).

2. OBJECTIVES

The purpose of this study was to assessment the effects of different irrigation regimes and several amount of nitrogen fertilizer on seed nutrition content and qualitative trait of wheat under the Mediterranean climatic conditions in Southwest of Iran.

3. MATERIALS AND METHODS

3.1. Field and Treatments Information

This research was carried out to evaluate effect of different irrigation regime and nitrogen fertilizer on nutrient concentration and protein percentage of wheat via factorial experiment based on completely randomized design with three replications. The factors consisted different irrigation regime (I_1=half of (50%) water demand, I_2= equal of water demand (100%) and I_3=1.5 (150%) water demand) and nitrogen fertilizer (N_1=nonuse of nitrogen or control, N_2=50%, N_3=75% and N_4=100% according soil test). The place of research was located in the Khuzestan agricultural and natural resource research center at latitude 31´50″N, longitude 48´28″E and altitude with 22m above the sea level. The climate is desert and arid, so it has long and very hot summers and almost mild winters. According to the long meteorological data and soil survey, the soil thermal regime is Hyperthermic and the soil moisture regime is Aridic. According to key to soil taxonomy classification the type of soil is the Fine Carbonatic hypertherimic Typic Torriorthents. Before the cultivation and fertilizer four soil sections were sampled at 0-30 cm depth. After mixing the samples, the resulting compound was analyzed. The soil test results showed that the soil is calcareous and it has low salinity concentration and had clay loam texture (Table 1).

Table 1. Physical and chemical properties of studied field

Item	Sand	Silt	Clay	Texture	$CaCO_3$	TNV	OC	pH	EC	P	K	Zn
Unit		%		-		%		-	$ds.m^{-1}$		$mg.kg^{-1}$	
Measured	7	47	46	Si.C.L	46	45	0.6	7.2	5.2	8.7	214	0.4

3.2. Farm Management

After determination of seed viability and 1000 seed weight, the Chamran cultivar, 500 seed per square meter was calculated for each sub crop. 250 $kg.ha^{-1}$ urea fertilizer was divided into four stages. At the beginning of cultivation, soil preparation was carried out for the experiment and based on the analysis of soil physical and chemical properties, the required amounts of nutrients except nitrogen were consumed uniformly. The net water requirement for wheat in the study area was about 4,000 cubic meters per hectare, which was calculated for each treatment. The amount of irrigation water was based on measuring soil moisture before irrigation up to 60 cm depth and reaching the field capacity, so the soil moisture content was measured by weight method. The amount of water reached to each experimental plot was measured and collected by catch can cans placed in the middle of each plot on a stand (80 cm). According to the plot, nitrogen fertilizer treatments were applied and wheat seeds were sown on 60 cm rows.

3.3. Measured Traits

After seed ripening and removing the margins, manually return the crop product from the floor to the floor by hand, the product of each plot was manually harvested from the ground by a sickle. Soil samples were transferred to the laboratory after compound sampling and air dried and passed through a 2 mm sieve. Soil texture by hydrometric method, soil acidity by pH meter, electrical conductivity by EC Meter, organic carbon by walkley black method, TNV percentage by back titration, phosphorus absorption by spectrophotometer, potassium by photoelectric flame photometer and nitrogen by Kjeldahl method were measured (Gee and Bauder, 1986). Qualitative traits such as nitrogen, phosphorus, potassium and protein were measured in laboratory after sampling. So, to calculate the protein percentage the following formula was used (Bremner *et al*., 1983): **Equ. 1.** Protein percentage= Nitrogen percentage* 5.8.

3.4. Statistical Analysis

In order to analyze the data, MSTAT-C software was used and to compare means treatment the Tukey test at 5% probability level was used.

4. RESULT AND DISCUSSION

4.1. Nitrogen concentration

According result of analysis of variance effect of different level of nitrogen fertilizer, irrigation regime and interaction effect of treatments on nitrogen concentration was significant at 1% probability level (Table 2).

Table 2. ANOVA result of measured traits

S.O.V	df	Nitrogen concentration	Phosphorus concentration	Potassium concentration	Protein concentration
Replication	2	0.0006^{ns}	0.0001^{ns}	0.001^{**}	0.268^{ns}
Irrigation regime (I)	2	0.167^{**}	0.0001^{ns}	0.003^{**}	7.903^{**}
Nitrogen (N)	3	1.082^{**}	0.0001^{ns}	0.003^{**}	34.142^{**}
I×N	6	0.169^{**}	0.0001^{ns}	0.004^{**}	5.379^{**}
Error	22	0.0101	0.0001^{ns}	0.0001^{ns}	0.837
CV (%)	-	6.35	3.25	1.19	9.73

^{ns}, * and ** are non-significant and significant at 5 and 1% probability levels, respectively.

Mean comparison result of different level of irrigation regime indicated that maximum nitrogen concentration was noted for half of water demand and minimum of that belonged to 1.5 water demand treatment, so increasing the volume of consumed water led to decrease the seed nitrogen concentration from 1.73 $mg.kg^{-1}$ to 1.49 $mg.kg^{-1}$ (Fig.1). Shabankareh (2018) stated increasing nitrogen use efficiency is important and strategies such as cultivars with higher nitrogen uptake efficiency change in fertilizer type, management time of fertilizer application and more split fertilizer need to be recommended.

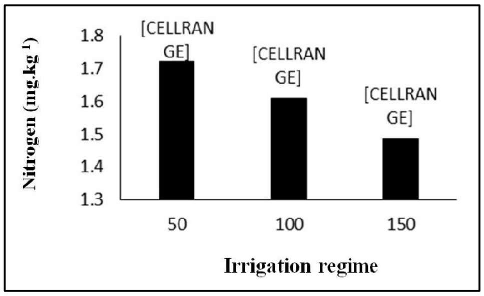

Fig. 1. Mean comparison effect of different level of irrigation on nitrogen concentration via Tukey test at 5% probability level.

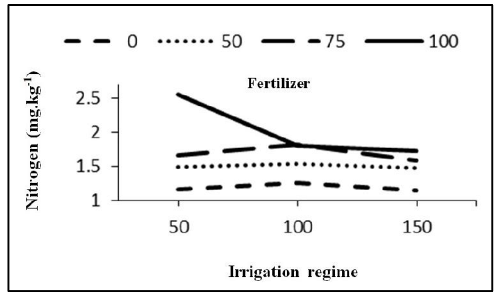

Fig. 3. Mean comparison interaction effect of treatments on nitrogen concentration via Tukey test at 5% probability level.

According to the Duncan classification made with respect to the different level of nitrogen fertilizer maximum and minimum amount of nitrogen concentration belonged to the 100% according soil test (2.1 $mg.kg^{-1}$) and nonuse of nitrogen or control treatments (1.25 $mg.kg^{-1}$) (Fig.2). Evaluation mean comparison result of interaction effect of treatments indicated the maximum nitrogen concentration (2.6 $mg.kg^{-1}$) was noted to the half of water demand and 100% according soil test and the lowest amount of measured trait (1.1 $mg.kg^{-1}$) belonged to the 1.5 water demand and nonuse of nitrogen treatment (Fig.3).

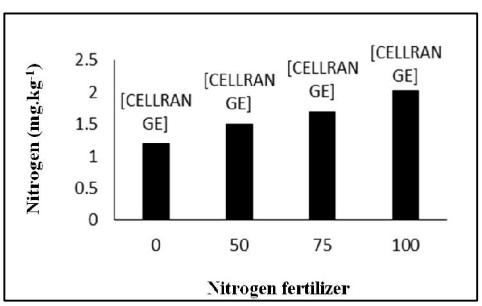

Fig. 2. Mean comparison effect of different level of nitrogen fertilizer on nitrogen concentration via Tukey test at 5% probability level.

4.2. Phosphorus concentration

Result of analysis of variance revealed effect of different level of nitrogen fertilizer, irrigation regime and interaction effect of treatments on phosphorus concentration was not significant (Table 2). According result of mean comparison maximum of phosphorus concentration (13.4 cm) was obtained for half of water demand and minimum of that (0.3530 $mg.kg^{-1}$) was for 100% water demand treatment (0.3515 $mg.kg^{-1}$) (Fig.4). Evaluation mean comparison result indicated in different level of nitrogen fertilizer the maximum phosphorus concentration (0.3555 $mg.kg^{-1}$) was noted for 50% according soil test and minimum of that (0.3450 $mg.kg^{-1}$) belonged to control treatment (Fig.5). Nitrogen fertilizer application didn't have significant effect on seed phosphorus content. It seems phosphorus uptake is regulated by magnesium so that nitrogen has no effect on phosphorus uptake. Assessment mean comparison result of interaction effect of treatments indicated maximum phosphorus concentration (0.36 $mg.kg^{-1}$) was noted for 100% water demand and 75% according soil test and lowest one

(0.34 mg.kg^{-1}) belonged to half of water demand and nonuse of nitrogen treatment (Fig.6).

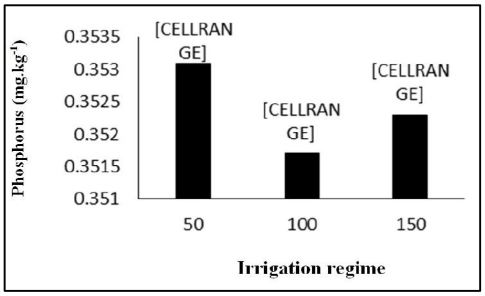

Fig. 4. Mean comparison effect of different level of irrigation on phosphorus concentration via Tukey test at 5% probability level.

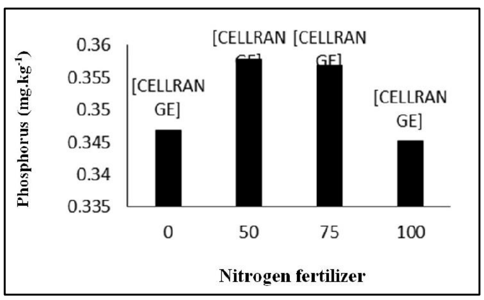

Fig. 5. Mean comparison effect of different level of nitrogen fertilizer on phosphorus concentration via Tukey test at 5% probability level.

4.3. Potassium concentration

According result of analysis of variance effect of different level of nitrogen fertilizer, irrigation regime and interaction effect of treatments on potassium concentration was significant at 1% probability level (Table 2). Assessment mean comparison result indicated in different level of irrigation regime the maximum potassium concentration (0.475 mg.kg^{-1}) was noted for 150% water demand and minimum of that (0.443 mg.kg^{-1}) belonged to 100% water demand treatment (Fig.7).

Due to the presence of K in the soil, as the amount of water consumed increases, the K solubility also increases, so the plant's K uptake will be increase.

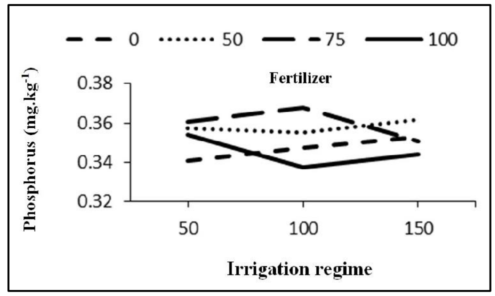

Fig. 6. Mean comparison interaction effect of treatments on phosphorus concentration via Tukey test at 5% probability level.

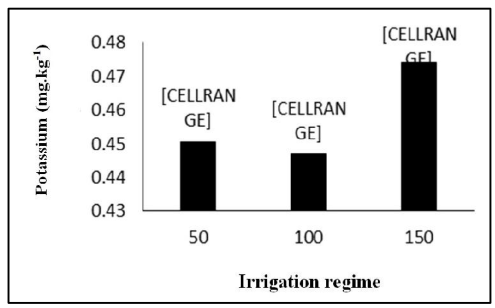

Fig. 7. Mean comparison effect of different level of irrigation on potassium concentration via Tukey test at 5% probability level.

Compare different level of nitrogen fertilizer showed that the maximum and the minimum of K concentration belonged to 75% according soil test (0.47 mg.kg^{-1}) and 100% according soil test (0.44 mg.kg^{-1}) treatments (Fig.8). Results showed that K content of seed increased with increasing nitrogen fertilizer application. But in 100% according soil test treatment, a significant decrease in K uptake was observed. Daily potassium uptake in the mid-growing season of wheat reaches a maximum of 2 kg.ha^{-1} when needed (Adams *et al.*, 2011).

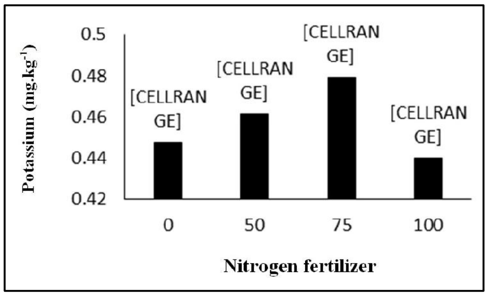

Fig. 8. Mean comparison effect of different level of nitrogen fertilizer on potassium via Tukey test at 5% probability level.

Maralian (2012) reported that wheat uptake of potassium was only 50 $kg.ha^{-1}$ under drought conditions, while in optimal growth conditions reached 200 $kg.ha^{-1}$. Evaluation mean comparison result of interaction effect of treatments indicated maximum potassium concentration (0.53 $mg.kg^{-1}$) was noted for half of water demand and 75% according soil test and lowest one (0.41 $mg.kg^{-1}$) belonged to 100% water demand and 75% according soil test (Fig.9).

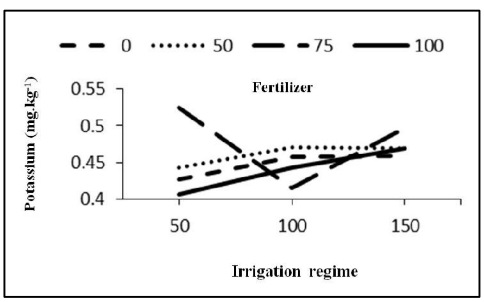

Fig. 9. Mean comparison interaction effect of treatments on potassium concentration via Tukey test at 5% probability level.

4.4. Protein concentration

Result of ANOVA showed effect of different level of nitrogen fertilizer, irrigation regime and interaction effect of treatments on protein was significant at 1% probability level (Table 2).

Evaluation mean comparison result revealed in different level of irrigation regime the maximum amount of protein concentration (10.3%) was noted for half of water demand and minimum of that (8.75%) belonged to 150% water demand treatment (Fig.10). So by increasing irrigation volume reduces seed protein content. Between different levels of nitrogen fertilizer the maximum protein concentration (11%) was observed in 100% according soil test and the lowest one (6%) was found in 75% according soil test treatment (Fig.11). Assessment mean comparison result of interaction effect of treatments indicated maximum protein concentration (15%) was noted for half of water demand and 100% according soil test and lowest one (6.5%) belonged to 150% water demand and nonuse of nitrogen treatment (Fig.12). Optimizing irrigation planning and management in low water areas advised avoid choosing more water, more yields and less water, and more productivity. Maralian (2008) reported same result.

5. CONCLUSION

Comparison of different irrigation treatments showed that increasing the volume of water decreased seed nitrogen content, increase potassium content and don't have significant effect on phosphorus content. Also increasing consumed water led to decreased ease seed protein content. The maximum protein concentration (15%) was noted for half of water demand and 100% according soil test.

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FOOTNOTES

AUTHORS' CONTRIBUTION: All authors are equally involved.

CONFLICT OF INTEREST: Authors declared no conflict of interest.

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