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Original article

The effect of alkazot, supplemental irrigation and nitrogen treatments on quantity and quality of wheat (*Triticum aestivum* L.)

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Extended abstract

Introduction

Wheat is considered a strategic crop that provides food for half of the world's population. Therefore, increasing wheat yield per unit area seems necessary due to the limited area of cultivation. Nitrogen is an essential mineral element in plant tissues, which is necessary for plant growth and metabolic processes. In the lack of nitrogen, the plant is unable to complete a normal life cycle. Nitrogen deficiency in plants will lead to slow or stopping growth, chlorosis and necrotic spots. Basically, biofertilizers not only increase yield of the crops, rather, they affect the effectiveness of most chemical fertilizers. Also, the use of supplemental irrigation increases crop yield and improves water use efficiency. So, research on increasing wheat yield per unit area will be necessary. The purpose of this study was to evaluate the effect of supplementary irrigation, alkazot biofertilizer and nitrogen fertilizer on the qualitative and quantitative characteristics of wheat.

Materials and methods

This experiment was carried out as factorial based on randomized complete block design with three replications at the research farm of Gonbad Kavous University in growing season during 2016-2017. Alkazot biofertilizer in two levels of non-consumption and 100 kg ha^{-1} and into brush seed and nitrogen fertilizer in four levels of non-application and application of 50, 100 and 150 kg per hectare as first factor and supplemental irrigation in two levels (non-irrigation and irrigation in seed filling stage) as second factor. In this study, the Gonbad cultivar of wheat was used. Planting and harvesting dates were December 25, 2016 and June 1, 2017, respectively. In the present study, half of nitrogen fertilizer and biological fertilizer were applied in sowing date. The rest of the nitrogen fertilizer was applied after emergence of spikes before rainfall. In this study, the measured traits included plant height, number of spikes per square meter, number of seeds per spike, 1000-grain weight, grain yield, protein percentage and protein yield.

Results and discussion

In the present experiment, alkazot fertilizer significantly affected plant height, number of grain per spike, 1000-grain weight, grain yield, protein percentage and yield. Overall, all of these traits under

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application treatment of alkazot fertilizer were more than non-application treatment with value of 4.16, 8.11, 12.04, 21.72, 3.74 and 26.40%, respectively. Supplemental irrigation also significantly affected 1000- grain weight, grain yield, protein percentages and yield. 1000-grain weight, grain yield, protein percentage and protein yield in irrigation treatment was 37.35 g, 5103 kg ha^{-1}, 14.40% and 739.8 kg ha^{-1}, respectively. In contrast, in non-irrigation treatment the amounts of these traits were 29.4g, 3787 kg ha^{-1}, 15.00% and 573.8 kg ha^{-1}, respectively. Effect of nitrogen on plant height, number of spikes per square meter, number of seeds per spike, 1000-grain weight, grain yield, protein percentage and yield were significant. Plant height, spikes per square meter, grain per spike, 1000-grain weight, grain yield, protein percentage and yield in non-application of nitrogen was 69.62 cm, 354.6 spike, 31.3 grain, 31.63 gr, 3502 kg/ha, 14.07% and 492.1 kg ha^{-1}, respectively. The maximum amount of plant height, spikes per square meter, grain per spike, 1000-grain weight, grain yield, protein percentage and yield with value of 73.95 cm, 440.4 spike, 35.74 grain, 34.59 gr, 5364 kg ha^{-1}, 15.54% and 831.8 kg ha^{-1} belonged to application of 150 kg N ha^{-1}, respectively .

Conclusion

According to the results, 150 and 100 kg per hectare of nitrogen had a significant effect on all measured traits of wheat cultivar except grain per spike in case of alkazot biofertilizer. While irrigation in reproductive stage affected just 1000-grain weight, seed yield, protein percentage and yield. According to the results, it can be concluded that the amount of rainfall and temperature at the time of vegetative growth in Gonbad Kavous County was sufficient that in the reproductive stage, once supplementary irrigation with the use of alkazot and nitrogen resulted in good quantitative and qualitative yield.

***Keywords*:** 1000-grain weight, Grain yield, Harvest index, Plant height, Protein

Table 1. Physical and chemical properties of the farm soil

Soil texture	Sand	Silt	Clay	K	P	Total N	pH	EC
	----------%----------			--------ppm--------		%		$dS.m^{-1}$
(Silty clay loam)	12	58	30	478	17.6	0.08	7.87	1.71

Table 2. Temperature, relative humidity and Rainfall during growth season

Month	Nov.- Dec.	Dec.- Jan.	Jan.- Feb.	Feb.- Mar.	Mar.- Apr.	Apr.- May	May-Jun.
Mean Temperature (°C)	8.2	8.4	6.7	11.7	14.8	21.4	26.7
Mean Relative humidity (%)	68	70	76	71	76	70	55
Rainfall (mm)	37.5	9	94.6	35.6	37.2	30.4	0.3

Table 3. Mean squares of traits under Alkazot, Supplemental irrigation and Nitrogen consumption

S.O.V	df	Traits						
		Plant height	Spike per m^2	Grain Per spike	1000-grain weight	Grain yield	Protein percentage	Protein yield
Repetition	2	6.488	131.3	12.19	7.415	166822	0.962	10867
Alkazot (A)	1	102.2**	4126	80.3**	77.42**	90984467**	3.575*	281215**
Irrigation (I)	1	44.76	2626	22.5	758.1**	20782272**	4.392*	327655**
Nitrogen (N)	1	42.24*	18266**	55.46**	19.64*	8522666**	5.229*	279404**
A×I	1	0.079	88.02	0.711	2.784	56.33	0.238	304.7
A×N	3	0.183	76.91	0.352	0.278	102805	0.145	5267
I×N	3	0.908	160.2	3.064	0.087	231238	0.318	4703
A×I×N	3	0.358	53.3	0.031	0.293	16381	0.281	794.4
Error	30	13.75	1100	8.665	5.845	183991	0.763	4179
CV%		*5.17*	*8.26*	*8.86*	*7.24*	*9.65*	*5.94*	*9.85*

* and ** : Significant at 5 and 1% probability, respectively.

Table 4. Mean comparison of traits under Alkazot

Alkazot	Traits					
	Plant height	Grain/spike	1000-grain weight	Grain yield	Protein	Protein yield
	cm		gr	$Kg.h^{-1}$	%	$Kg.h^{-1}$
Application	73.13^{a}	34.53^{a}	34.64^{a}	4881^{a}	14.97^{a}	733.0^{a}
Non application	70.21^{b}	31.94^{b}	32.1^{b}	4010^{b}	14.43^{b}	579.9^{b}
LSD 5%	*2.19*	*1.74*	*1.43*	*252.9*	*0.52*	*38.11*

The non-similar letters in each column indicate a significant difference at 5% probability level based on LSD

Table 5. Mean comparison of traits under nitrogen consumption

Nitrogen	Traits						
	Plant height	Spike/m^2	Grain/spike	1000-grain weight	Grain yield	Protein	Protein yield
$kg.ha^{-1}$	cm			gr	$Kg.h^{-1}$	%	$Kg.h^{-1}$
0	69.62^{b}	354.6^{c}	31.3^{b}	31.63^{b}	3502^{d}	14.07^{c}	492.1^{d}
50	70.8^{b}	385.4^{b}	31.6^{b}	33.28^{ab}	4012^{c}	14.29^{bc}	573.3^{c}
100	72.31^{ab}	425.8^{a}	34.31^{a}	33.98^{a}	4903^{b}	14.9^{ab}	728.5^{b}
150	73.95^{a}	440.4^{a}	35.74^{a}	34.59^{a}	5364^{a}	15.54^{a}	831.8^{a}
$LSD_{5\%}$	*3.09*	*27.65*	*2.45*	*2.02*	*357.6*	*0.73*	*53.9*

The non-similar letters in each column indicate a significant difference at 5% probability level based on LSD

Table 6. Mean comparison of traits under supplemental irrigation

Irrigation	1000-grain weight	Grain yield	Protein percentage	Protein yield
	gr	$Kg.h^{-1}$	%	$Kg.h^{-1}$
Supplemental irrigation	37.35^{a}	5103^{a}	14.40^{b}	739.1^{a}
Non irrigation	29.4^{b}	3787^{b}	15.00^{a}	573.8^{b}
$LSD_{5\%}$	*1.43*	*252.9*	*0.52*	*38.11*

The non-similar letters in each column indicate a significant difference at 5% probability level based on LSD