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OPTIMUM NITROGEN RATE FOR TWO BARLEY CULTIVARS UNDER THE ENVIRONMENTAL CONDITIONS OF MIDDLE EGYPT

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ABSTRACT

Two field experiments were carried out at Mallawy Agric. Res. station, Minia Governorate, in the two successive winter seasons of 2014/2015, and 2015/2016, to study the effect of nitrogen rates (10, 20, 30 and 40 kg.N/fed.) on growth and productivity of two barley cultivars (Giza 123 and Giza 2000). The results could be summarized as follows:-

- The two tested cultivars did not significantly differ in all studied traits except 1000-grain weight for Giza 2000 gave higher 1000-grain weight compared with Giza 123 in both seasons.
- Nitrogen rates exerted significant effects on plant height, 1000-grain weight, grain yield, straw yield and biological yield in both seasons. The N rate of 40 kg/fed. produced the highest values of plant height, straw and biological yields, while the N rate of 30 kg/fed.gave the highest grain yield and 1000-grain weight in both seasons.
- The interaction between barley cultivars and N rate did not exert any significant effects on all studied traits in both seasons, indicating that the two tested cultivars responded similarly to N rate.
- It could be concluded that the application of N at the rate of 30 kg/fed. Was sufficient to give the highest grain yield of both tested barley cultivars under the environmental conditions of middle Egypt.

INTRODUCTION

In Egypt, the demand for cereal crops is ever increasing to be consistently far above the local production of these crops. Therefore, much concern is steadily devoted to

enhance the local production of cereal crops. In this connection, barley may be advantageous as being the cereal crop that is the most reproductive under adverse environmental and the most adapted to the new reclaimed areas. It is well accepted that enhancing crop productivity could be achieved by developing high yielding cultivars and improving its cultural practices.

Nitrogen is the key element in achieving high yields in cereals. The application of N fertilizer contributes greatly to increase grain yield in barley (Sarhan *et al*, 2002, Ash-Shormilles *et al*., 2008, and El-Metwally *et al*., 2010). However, increasing N supply beyond a certain limit induced lodging and ultimately decreased barley grain yield and its components (Shafi *et al*., 2011). Besides, N fertilizer is not only a costly input, but also a contaminating element to the agroecosystem. Thus, efficient N use is of agronomic, economic and ecological significance. Enhancing the N use efficiency could be approached through efficient farming techniques and the use of plant varieties that have better N use efficiency (Abd El-Maksoud and Abdalla, 2003).

Barley growth increased significantly and linearly with increasing N application rate (Sarhan *et al*., 2002; Ash-Shormilles *et al*., 2008; El-Metwally *et al*., 2010 and Shafi *et al*., 2011), otherwise, barley yield was maximized at various N rates; 45 kg N/fed. (Youssef *et al*., 2004); 60 kg N/fed. (El-Metwally *et al*., 2010); or 90 kg N/fed. (Sarhan *et al*., 2002 and Ash-Shormilles *et al*., 2008). The amount of nitrogen that a barley crop needs to maximize growth yield and its components depends on seasonal conditions, soil type, and the rotational history of the soil as well as the potential yield of the crop (Shafi *et al*., 2011). Several workers reported that barley cultivars showed significant differences in yield and its attributes (Abdel-Hamid and Mohamed, 2000 and Shafi *et al*., 2011). On the other hand, Abdel-Hamid *et al*., (2001) pointed out that barley cultivars did not significantly differ in grain yield. With regard to the effect of interaction between barley cultivars and N rates, the cultivars responded differently (Alazmani, 2014); inconsistently (Ash-Shormilles *et al*., 2008 and Ryan *et al*., 2009); or similarly (Shafi *et al*., 2011).

The main goal of this study was to determine the optimal nitrogen rate for two barley cultivars i.e. Giza 123 and Giza 2000 under the environmental conditions of Middle Egypt.

MATERIALS AND METHODS

The present investigation was conducted at Mallawy Agric. Res. Station, during the two successive winter seasons of 2014/2015 and 2015/2016 , to study the effect of nitrogen rate on yield and yield components for barley cultivars. The soil type of experimental site was silty clay loam. The mechanical as well as the chemical analyses of the soil are shown in Table (1).

In the two experiments, the barley was proceeded by maize in the two seasons. Each experiment included 8 treatments which were the combination of two varieties (Giza123 and Giza2000) and four rates of nitrogen (10, 20, 30 and 40 kg N / fed.) in the form of ammonium nitrate (33.5%N) which were added before the second irrigation. The experiment was arranged in split plot design with three replicates. The main plots included two cultivars, while the N rates were randomly assigned to the sub plots. The sub plot size was (3.5 X 2.5m). All other inputs and agronomic practices were carried out uniformly.At harvest where plants of square meter per each experimental plot were collected to estimate, grain yields (ard / fed). Straw yields (ton / fed) and biological yield (ton / fed). Ten shoots were taken from each sub – plot and following traits were measured: plant height (cm) spike length (cm) and 1000 grain weight (g).

Data were analyzed statistically for analysis of variance (ANOVA) following the method described Gomez and Gomez (1984). MSTAT computer software was used to carry out statistical analysis. The significance of differences among means was compared using Least Significant Difference (LSD) test (Steel, and Torrie, 1997).

Table (1): Some mechanical and chemical properties of the experimental site soil .

Soil property		2014/2015	2015/2016
Physical analysis	Sand %	7.75	8.25
	Silt%	53.70	52.50
	Clay%	38.55	40.25
	Soil texture	Silty clay loam	Silty clay loam
Chemical analysis	Organic mater %	1.14	1.32
	Soluble ions (meq/100g soil (1:5))		
	CO_3^- (meq/L)	---	1.72
	HCO_3^- (meq/L)	3.20	4.50
	Cl^- (meq/L)	4.10	3.80
	$SO_4^=$ (meq/L)	5.27	4.10
	Ca^{++} (meq/L)	7.45	8.02
	Mg^{++} (meq/L)	2.15	2.90
	Na^+ (meq/L)	3.22	4.60
	K^+ (meq/L)	0.20	0.35
	EC (ds/m)(1:5)	1.26	1.50
	pH(1:1)	8.30	7.90
	Available N (ppm)	18.25	20.15
	Available P (ppm)	7.58	8.10
	Available K (ppm)	156.00	170.15

RESULTS AND DISSCUTION

Results in Table (2) revealed that differences between the two tested cultivars were not significant except 1000-grain weight for Giza2000 gave higher weight compared with Giza 123 in both seasons. Also, significant varietal differences in 1000-grain weight were reported by Ash-Shormilles *et al*., (2008) and Alazmani (2014). Abdel-Hamid *et al*., (2001) found that barley cultivars did not significantly differ in grain yield.

Table (2): Effect of barley cultivars on growth, yield and yield components in two seasons (2014/2015 and 2015/2016).

	Treatments						
Barley cultivars	Plant height (cm)	No. of days to heading	Spike length (cm)	1000-grain weight (g)	Grain yield (ard/ fed.)	Straw yield (ton/ fed)	Biological Yield (ton/ fed.)
First season (2014/2015)							
Giza-123	108.6	77.8	8.7	53.7	10.5	4.632	5.890
Giza-2000	115.8	80.4	7.5	58.2	12.2	4.891	6.360
L.S.D. 0.05	N.S	N.S	N.S	2.82	N.S	N.S	N.S
Second season (2015/2016)							
Giza-123	110.9	87.2	7.3	49.7	16.8	6.422	8.435
Giza-2000	108.8	89.5	6.9	58.1	13.2	5.942	7.530
L.S.D. 0.05	N.S	N.S	N.S	5.12	N.S	N.S	N.S

Data presented in Table (3) indicated that N application rate significantly affected plant height, 1000-grain weight, grain yield, straw yield and biological yield in the two seasons. While number of days to heading and spike length were not significantly influenced by N rate. Increasing N rate tended to increase number. of days to heading but the differences did not reach the level of significancein the two seasons.

Plant height, straw yield, and biological yield were significantly and linearly increased with increasing N rate from 10 kg/fed up to 40 kg N/fed. which gave the highest values of these traits. This could be attributed to the well-known effect for N in stimulating plant growth and biomass production via its structural and enzymatic roles within plants. Similar results were obtained by Sarhan *et al*., (2002). Ash-Shormilles *et al.*, (2008). and Ryan *et al.*, (2009).

Maximum values of grain yield and 1000-grain weight were obtained at the rate of 30 kg N/fed. followed by 40 kg N/fed. in both seasons. These results are in general agreement with those of Shafi *et al.*, (2011). Responses of barley yield and its components to N rates among different studies could be attributed to the differences in soil

properties, cultivars and environmental conditions (some properties of soil of the present study are shown in Table 1). In this relation, Shafi *et al*., (2011) concluded that the amount of N that a barley crop needs to maximize yield and quality depends on the seasonal conditions, soil type and rotational history of the soil as well as the potential yield of the crop.

Table (3) Effect of N application rate on growth, yield and yield components of barley cultivars in the two seasons (2014/2015 and 2015/2016).

	Treatments						
Nitrogen rate (Kg.N./fed.)	Plant height (cm)	No. of days to heading	Spike length (cm)	1000-grain weight (g)	Grain yield (ard/fed.)	Straw yield (ton/fed.)	Biological Yield (ton/fed.)
First season (2014/2015)							
10	118.8	78.7	8.0	55.3	10.6	4.344	5.620
20	111.7	79.0	7.7	55.2	11.0	4.698	6.020
30	113.1	79.0	8.2	58.0	12.8	4.763	6.300
40	115.2	79.8	8.5	55.3	11.0	5.240	6.560
L.S.D.0.05	4.8	N.S	N.S	2.37	1.39	0.36	3.588
Second season (2015/2016)							
10	107.5	87.7	7.2	51.5	12.5	5.571	7.070
20	108.3	87.8	6.9	53.4	14.1	5.824	7.520
30	110.5	88.3	6.9	57.1	19.0	6.159	8.440
40	113.2	89.5	7.5	53.6	14.4	7.173	8.900
L.S.D. 0.05	5.1	N.S	N.S	2.46	2.37	0.63	5.68

Results shown in Table (4) clearly revealed that the interaction among barley cultivars and N application rates did not exert any significant effects on all studied traits in both seasons, indicating that the two tested cultivars responded similarly to N rate. These results are in accordance with those of Shafi *et al*., (2011). Meanwhile, Ryan *et al*., (2009). and Ash-Shorimilles *et al*., (2008). reported that each of N rate and cultivars exerted significant effects on barley growth and yield, but their interaction effects were less consistent.

It could be concluded, from the obtained results, that the N rate of 30 kg N/fed. gave the highest grain yield of both barley cultivars in both seasons under the environmental conditions of middle Egypt .

Table (4): Effect of the interaction between nitrogen rate and cultivars on yield and yield components of barley in two seasons (14/2015 and 15/2016).

Barley cultivars	Nitrogen rate (kg.N/fed)	Treatments						
		Plant height (cm)	No. of days to heading	Spike length (cm)	1000-grain weight (g)	Grain yield (ard/ fed)	Straw yield (ton/ fed)	Biological Yield (ton/ fed)
First season (2014/2015)								
Giza/123	10	105.0	76.7	8.4	52.2	9.8	4.180	5.360
	20	108.3	78.0	8.7	52.5	9.7	4.634	5.800
	30	109.3	77.7	8.7	57.1	12.2	4.536	6.000
	40	111.7	79.0	9.2	52.9	10.2	5.178	6.400
Giza/2000	10	112.7	80.7	7.5	58.4	11.4	4.502	5.880
	20	115.0	80.0	6.8	57.9	12.3	4.762	6.240
	30	117.0	80.3	7.7	58.8	13.4	4.990	6.600
	40	118.7	80.7	7.8	57.8	11.8	5.302	6.720
L.S.D. 0.05		N.S	N.S	N.S	N.S	N.S	N.S	N.S
Second season (2015/2016)								
Giza/123	10	108.3	87.0	7.4	47.4	15.1	5.912	7.720
	20	108.7	87.0	7.2	48.5	16.1	6.074	8.000
	30	112.0	86.7	6.9	52.9	20.6	6.206	8.680
	40	114.7	88.0	7.9	49.8	15.4	7.494	9.340
Giza/2000	10	106.7	88.3	7.0	55.6	9.9	5.230	6.420
	20	108.0	88.7	6.0	58.3	12.2	5.574	7.040
	30	109.0	90.0	6.9	61.2	17.4	6.112	8.0200
	40	111.7	91.0	7.1	57.3	13.4	6.825	8.460
L.S.D. 0.05		N.S	N.S	N.S	N.S	N.S	N.S	N.S

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معدل التسميد النيتروجيني الأمثل لصنفين من الشعير تحت الظروف البيئية لمصر الوسطي

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أقيمت تجربتان حقليتان في محطة البحوث الزراعية بملوى والتابعة لمركز البحوث الزراعية- بمحافظة المنيا خلال موسمي الزراعة الشتوية 2015/2014م , 2015 / 2016م بهدف دراسة تأثير معدل التسميد النتروجينى (10، 20، 30، 40 كجم/فدان) على المحصول ومكوناته لصنفى الشعير جيزة 123 و جيزة 2000 وأوضحت هذه الدراسة ما يلى:

1- أظهرت النتائج أنه لم تكن هناك فروق معنوية بين الصنفين محل الدراسة فى كل الصفات المدروسة ماعدا وزن 1000حبة حيث أعطى الصنف جيزة 2000 زيادة معنوية فى وزن 1000حبة مقارنة بالصنف جيزة 123 فى كلا الموسمين.
2- أظهر معدل التسميد النتروجينى تأثير معنوى على طول النبات ووزن 1000حبة ومحصول الحبوب ومعدل القش والمحصول البيولوجى فى كلا الموسمين، وأعطى المعدل 40كجم نتروجين/فدان أعلى القيم فى طول النبات ومحصول القش والمحصول البيولوجى فى كلا الموسمين بينما أعطى المعدل 30كجم نتروجين/فدان أعلى محصول للحبوب وأعلى وزن 1000حبة فى كلا الموسمين.
3- لم يظهر التفاعل بين الاصناف ومعدل التسميد النتروجينى أى تأثير معنوى على كل الصفات تحت الدراسة فى كلا الموسمين أى أن الصنفين محل الدراسة لم يظهرا إختلاف فى الاستجابة لمعدل التسميد النتروجينى.

يمكن ان نستخلص من هذة الدراسة أن إضافة السماد النتروجينى بمعدل 30كجم نتروجين/فدان كان كافياً للحصول على أعلى محصول من صنفى الشعير جيزة 123 وجيزة 2000 تحت الظروف البيئية لمنطقه مصر الوسطي.