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EFFECT OF NITROGEN LEVELS AND BIOFERTILIZER SOURCES ON TWO BARLEY CULTIVARS.

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ABSTRACT

Two field experiments were carried out at Sakha Agricultural Research Station, during 2001/2002 and 2002/2003 seasons to study the response of two barley cultivars (Giza 123 and Giza 2000) to nitrogen levels (0, 30 and 45 kg N/fad.) and biofertilizer sources (noninoculated, microbin, nitrobin, cerialin and rizobactreren). A split-split plot design with four replications was used in this study. The studied trait were; days to heading, days to maturity, plant height, number of spikes/m^2, spike length, number of grains/spike, 1000-grain weight, biological, grain and straw yields/fad., harvest index, crude protein %,and protein yield /fad.

The results indicated that Giza 123 cultivar gave the highest values of plant height, number of spikes/m^2, spike length, 1000-grain weight, and biological, grain, straw and protein yields/fad. On the other hand the lowest values were obtained using Giza 2000 cultivar..

With respect to nitrogen, increasing it's level from 0 to 45 kg N/fad. Led to significant increases in all studied traits except in case of 1000 grain weight.

The results also showed that all biofertilizer treatments significantly increased grain yield, yield components and its quality traits. Meanwhile, the highest values were recorded when seed was inoculated with Nitrobin.

It could be concluded that cultivation of Giza 123 under 45 kgN/fad. combined with any of the studied biofertilizer sources give the best agronomic and quality traits.

INTRODUCTION

Barley is the main cereal crop grow along the Northern coast of Egypt under rainfed conditions, and in the newly reclaimed lands and the old ones. Barley has been recognized as an adapted crop to adverse conditions as heat, salinity, drought and poor soils. It could survive and grow satisfactory under such conditions than several other crops.

The major use of barley is for animal feeding and breweries industry. However, there is an interest in using it as human food in regions where other cereals can not grow well due to latitude, low rainfall, or soil salinity. In addition to grain uses, straw is used for animal bedding, and immature barley plants are harvested for grazing hay or silage. In Egypt, barley faces severe competition in the old valley with other winter crops; i.e., wheat, beet, food legumes and clover etc.

A wide variation among barley cultivars in grain yield, yield components and quality were reported by many investigators; Bulman and smith (1993), Noaman *et al.* (1997), Oscarsson *et al.* (1998), Afifi (1999) and EL-Hag (2001).

Nutrition is essential for plant life and production, therefor; mineral fertilization and agronomic practices lead to improve productivity.

Nitrogen fertilizer contributed greatly to improve grain yield. Although nitrogen fertilizer effects on barley production has been exclusively studied, further studies on determining the optimum nitrogen level is still needed. Moreover the importance of nitrogen source is still debatable. Birch *and* Long. (1990), Lauer and Partridge (1990), Dirienzo *et al.*(1991), EL-Sayed *et al.*(1991),Osman *et al.*(1991), Gomaa (1992),Zaid (1992), Conry (1994), Allam (1997), Oscarsson *et al.* (1998), and Munir (2002).

Biofertilizers are N_2-fixing bacteria and contribute to nitrogen requirements for barley plants. Inoculation with N_2- fixing bacteria increased field crop production even in agricultural systems where mineral nitrogen supplementation is not major problem (Mitkees *et al* 1996), Said (1998), Ahmed (2001), Megahed and Samia, Mohamed (2001) and Farag (2003).

The importance of bio-fertilization is to limit mineral N level, pollution due to N-dinitrification products that affect ozone and increase production coasts (Zaid,1992).

Therefore, the objectives of this study are to determine the effect of biofertilizers (N2-fixing bacteria).and effect of N levels on the productivity, and some related agronomic and quality traits.

MATERIALS AND METHODS

Two field experiments were conducted in 2001/2002 and 2002/2003 growing seasons at Sakha Agricultural Research Station, Agricultural Research Center, Egypt, to study the effect of three nitrogen levels and four biofertilizer sources on two barley cultivars, the preceeding crop was cotton in the first season and maize in the second one.

Phosphours was added as super phosphate 15.5% P_2O_5 (15 kg P_2O_5/fad.) during land preparation. In both seasons , sowing was carried out on 14 th. Decembrer, in rows by hand with 200 seeds/m^2. Data of soil texture and chemical analysis of the experimental field are given in Table 1.

The experimental design was split split plot with four replications. The main plots were assigned to the cultivars (Giza 123 and Gaiza 2000). The three nitrogen levels (0, 30 and 45 kg N/fad.) were distributed in the sub plots. Nitrogen fertilizer was applied in the form of ammonium nitrate (33.5% N) and adding at two equal doses; at sowing and at tillering stage. The sub – sub plots were randomly assigned to five biofertilizer treatments (noninoculated, Microbin, Nitrobin, Cerialin and Rizobacteren), and they were added with seeds at rate of 500 g /fad.

The sub –sub plot area was six rows, 3.5 m long and 20 cm apart making an area of 4.2 m^2 The central four rows were used to determine yield and yield attributes.

The Studied Characters were: heading and maturity dates, plant height (cm), number of spikes per square meter, spike length (cm);number of grains/spike, 1000 grain weight(gm), biological yield (ton/fad.), grain yield (ardab/fad.) straw yield (ton/fad.), harvest index % (grain yield / biological yield x 100), crude protein % and protein yield (kg/fad.).

Table 1: Soil analysis of the experimental field in 2001/2002 and 2002/2003 seasons.

Determination	Season	
	2001/02	2002/03
Physical Analysis;		
Sand %	19.1	16.2
Silt %	34.9	35.2
Clay %	46.0	48.6
Texture	Clay	Clay
Chemical Analysis		
Available N (ppm)	38.0	45.3
Available P (ppm)	15.2	13.3
Available K(ppm	289.7	261.3
pH	7.8	7.8
EC(m-mhos/cm)	3.2	2.7
$CaC0_3$ %	3.2	2.9
Organic Matter	1.81	1.89

The Analysis of variance was carried out according to Gomez and Gomez (1984). Treatment means were compared using Duncan's Multiple Range Test (Duncan,1955). The statistical analysis was performed using "MSTAT-C" computer software package.

RESULTS AND DISCUSSION

The obtained data of the studied characters of the two cultivars as influenced by nitrogen levels and biofertilizer sources will be explained as follows :

A. Agronomic Characters:

A.1 Heading date:

Data in Table 2 showed that insignificant difference in heading date between the two cultivars for this trait in both seasons. However, Giza 123 was earlier than Giza 2000.

Concerning, nitrogen levels, the data showed significant effect on this criterion in both seasons. In general, increasing nitrogen levels up to 45 kg N/ fad. increased the vegetative growth period and hence, delayed heading date compared to the control, Table 2. These results are in harmony with those of Sharshar *et al.* (1995), Said (1998), Amer (1999) and El-Sharaawy (2003).

Regarding the effect of biofertilizers, the data showed significant differences, Table 2. The latest heading dates were recorded from the inoculation treatments, whereas, noninoculation ones were earlier in this trait. These results are in agreement with those of Megahed and Samia, Mohammed (2001).

Table 2: Overall mean values of earliness characteristies of the two barley cultivars as affected by the nitrogen levels and biofertilizers and their interactions in 2001/2002 and 2002/2003 seasons

Variable	headingdate		maturity date	
Year	2001/2002	2002/2003	2001/2002	2002/2003
Cultivar (C)				
Giza 123	83.0	91.8	123.1	129.1
Giza 2000	83.8	92.7	123.8	129.9
F.test	NS	NS	NS	NS
Nitrogen levels (N) kg/fad.(N)				
0	81.2c	90.2c	121.2c	127.2c
30	83.3b	92.3b	123.3b	129.4b
45	85.7a	94.1a	125.8a	131.9a
F.test	**	**	**	**
biofertilizer (B)				
Control	82.4b	91.0b	122.5b	128.5b
Cerealin	83.9a	93.0a	124.2ab	130.0a
Nitrobin	83.2ab	93.2a	123.5ab	129.3ab
Microbin	83.5ab	91.1b	123.5ab	129.5ab
Rizobacteren	84.1a	92.8a	124.1a	130.1a
F.test	*	**	**	*
Interactions				
CN	NS	NS	NS	NS
CB	NS	**	NS	NS
NB	NS	**	NS	NS
CNB	NS	NS	NS	NS

***,** and NS indicate $P < 0.05$, $p < 0.01$ and not significant, respectively.**
Means designated by the same letter are not significantly different at 5 % level according to Duncan ' s Multiple Range Test

Data in Table 3 showed that heading periods for the two cultivars were delayed due to inoculation with Rizobacteren, Nitrobin and Cerealin. On the other hand, the shortest periods were recorded from control and Microbin treatments

Data in table 4 showed that the longest periods of heading date were recorded from Rizobacteren, Nitrobin, Cerealin + 45 Kg N /fad., while the shortest ones were recorded from control (uninoculated).

A.2.Maturity date:

Table 2 indicate insignificant differences existed between the two cultivars for this trait.

Regarding nitrogen levels the data revealed significant effect on this trait, where increasing nitrogen levels increased number of days to maturity in both seasons. The shortest periods were recorded from the control treatment, while, the longest ones were obtained at 45 kg N/fad. in both seasons, Table 2. These results are in accordance with those of Amer (1999) , El-Hag (2001) and El-Sharaawy (2003)

Table 3: Overall mean values of heading date as affected by the interaction between cultivars and biofertilizers in 2002/2003 season.

Cultivars	Biofertilizer treatments Control	Cerealin	Nitrobin	Microbin	Rizobacteren
Giza 123	90.2 e	92.7 c	92.8 bc	90.4 e	92.9 bc
Giza 2000	91.9 d	93.3 ab	93.5 a	91.8 d	92.7 c

Means designated by the same letter are not significantly different at 5 % level according to Duncan ' s Multiple Range Test

Table 4: Overall mean values of heading date (days) as affected by the interaction between nitrogen levels and biofertilizers in 2002/2003 season.

Nitrogen Levels (kg/fad)	Biofertilizer treatment Control	Cerealin	Nitrobin	Microbin	Rizobacteren
0	88.8 g	90.6 e	90.9 e	89.8 f	91.1 e
30	91.1 d	93.4 c	93.4 c	91.1 de	93.1 c
45	93.5 c	95.1 a	95.3 a	93.3 c	94.2 b

Means designated by the same letter are not significantly different at 5 % level according to Duncan ' s Multiple Range Test.

Concerning the effect of biofertilizers, the results in Table 2 show significant differences among them. The longest periods were obtained from Rizobacteren, Cerealin, Microbin and Nitrobin, whereas, control treatment gave the shortest period in both seasons.

The interactions among cultivars, nitrogen levels , and biofertilizers, were insignificant in both seasons.

B. Yield and Its Attributes :

Table 5 show the results of plant height , number of spikes / m^2 , spike length, number of grains / spike , 1000- grain weight., biological yield, grain yield , straw yield and harvest index.

B.1.Plant height:

In both seasons, the analysis of variance showed that Giza 2000 was taller than Gîza 123. However, such differences did not reach the level of significant (Table 5).

Concerning Nitrogen levels, the results revealed highly significant effect. In general, 45 Kg N / fad gave the tallest plants, 127.04 and 118.53 cm, in the two seasons, respectively. The increases in plant height may be attributed to nitrogen levels. The increases internode length which were inturn due to cell division and elongation by the promotion of N on the meristimic activity of the plant . These findings are in harmony with those of **Kortam** (1995), Amer(1999), Sobh *et al* (2000), El-Hag (2001) and El- Shaarawy

(2003).Regarding biofertilizers, results showed significant effect in the first season, where inoculation with all biofertilizers gave the tallest plants followed by control treatment. These results are in good agreement with those of Fayez (1990), Sharief *et al* (1998), Mehasen (1999), Mashhoor *et al* (2001), El- Kalla *et al* (2002) and Khafagy (2003).

With respect to interaction, data in Table 6 showed that Giza 2000 and Giza 123 gave the tallest plants with any source of biofertilizer + 45 Kg N/fad. However, the shortest plants were obtained at any source of biofertilizer + 0 nitrogen in both seasons.

Table 5: overall mean values of plant height,number of spike/m^2, spike length of two barley cultivars as affected by nitrogen levels and biofertilizers and their interactions in 2001/2002 and 2002/2003 seasons

Variable	plant height		No. spike/m2		spike length	
Year	2001/02	2002/03	01/02	02/03	01/02	02/03
Cultivars (C)						
Giza 123	115.24	106.01	487.0	444.3	6.38	6.08
Giza 2000	116.08	107.61	444.0	400.8	6.31	6.02
F.test	NS	NS	*	*	NS	NS
Nitrogen levels (kg N/fad)						
0	101.47c	92.09c	361.8c	311.0c	5.62c	5.34c
30	118.48b	109.82b	463.9b	426.5b	6.43b	6.13b
45	127.04a	118.53a	571.0a	530.2a	7.00a	6.69a
F.test	**	**	**	**	**	**
biofertilizer (B)						
Control	112.95c	104.41	454.2	372.8c	6.05c	5.75c
Cerealin	116.12b	107.34	473.9	447.6a	6.37ab	6.08ab
Nitrobin	117.58a	107.61	475.6	450.6a	6.53a	6.24a
Microbin	115.6b	106.15	455.5	412.0b	6.33b	6.03b
Rizobacteren	116.07b	107.97	468.5	430.0ab	6.47ab	6.17ab
F.test	*	NS	NS	**	**	**
Interactions						
CN	NS	NS	*	NS	NS	NS
CB	NS	NS	NS	NS	**	**
NB	NS	NS	*	*	**	**
CNB	*	**	NS	NS	*	*

***,** and NS indicate P < 0.05, p< 0.01 and not significant, respectively.**
Means designated by the same letter are not significantly different at 5 % level according to Duncan ' s Multiple Range Test

B.2. Number of spikes / m^2:

In both season, data in Table 5 indicated significant differences existed between the two cultivars, for this trait, where Giza 123 outnumbered Giza 2000. This results are in good agreement with those of **Saleh (2001)** and El- Hag (2001).

Regarding nitrogen levels the results showed highly significant effect, where number of spikes /m^2 obtained at 45 Kg N / fad. outnumbered the other rates for this trait. Table 5. These results are in harmony with those of Basha and Bana (1994), Romas *et al* (1995), Ahmedvand *et al* (2002) Maksoud *et al* (2002) and Farag (2003).

Concerning biofertilizers, the data revealed insignificant effects on this trait in the first season and highly significant effects in the second one. In general, Nitrobin, Cerealin and Rizobacteren ranked first with insignificant differences followed by Microbin, and the control treatment, (Table 5). The higher spike number obtained due to biofertilizers may be attributed, to encouragement of spike formation and cell division which associated with nutrients and hormones. Moreover, this increases may be due to the effect of nitrogen which produced by bacteria in addition to cytokinens, GA3 and IAA which increase vegetative growth and increase number of spikes / m2. These results are agree with those of Hamed (1998) , Said (1998), El-Kalla *et al.* (2002) and Farag(2003).

Data in table 7 showed that the highest number of spikes/m^2 for Giza 123 were obtained at all treatments and Giza 2000 were obtained with Cerealin or Nitrobin only.

Table 6: Overall mean values of plant height (cm) as affected by the interaction among cultivars, nitrogen levels and biofertilizers in 2001/2002 and 2002 / 2003 seasons.

Cultivars	Nitrogen Levels (kg/fad)	Biofertilizer treatment				
		Control	Cerealin	Nitrobin	Microbin	Rizobacteren
				2001 /2002		
	0	96.17 h	103.58 g	105.42 g	98.5 gh	104.96 g
Giza123	30	114.88 f	118.46 d-f	118.63 d-f	119.04 c-e	117.75 d-f
	45	124.75 a-d	126 a-c	126.5 ab	128 a	126.04 a-c
	0	98.92 gh	101.17 gh	103.33 g	101.75 gh	100.92 gh
Giza2000	30	117.13 ef	120.08 b-f	122.71a-e	118.67 d-f	117.5 ef
	45	125.87 a-c	127.42 a	128.88 a	127.67 a	129.25 a
				2002/2003		
	0	92.58 h-j	95.58 h	86.38 j	86.75ij	97.88 h
Giza123	30	105.88 g	108.46 fg	109.88 e-g	109.29 fg	108.67 fg
	45	115.75 a-e	117.5 a-d	118.25 a-c	120 ab	117.38 a-d
	0	88.17 ij	91.67 h-j	97.08 h	92.83 hi	92 h-j
Giza2000	30	110.38 e-j	112.33 c-f	113.71 b-f	107.83 fg	111.75 d-g
	45	117.21 a-d	118.5 a-c	120.38 a	120.17 ab	120.17ab

Means within the same season designated by the same letter are not significantly different at 5 % level according to Duncan ' s Multiple Range Test.

Table 7: the overall mean values of number of spikes / m^2 as affected by the interaction between cultivars and biofertilizers in 2001 /2002.

Cultivars	Biofertilizer treatment Control	Cerealin	Nitrobin	Microbin	Rizobacteren
Giza 123	480.6abc	494.3ab	498.1a	474.2abc	488.0ab
Giza 2000	427.8d	453.5a-d	453.2a-d	436.9cd	448.9bcd

Means designated by the same letter are not significantly different at 5 % level according to Duncan' s Multiple Range Test.

The interaction effect between nitrogen levels and biofertilizers were significant. Data in Table (8) showed that Cerealin or Nitrobin + 45 Kg N / fad. gave the highest number of spikes per square meter.

Table 8: overall mean values of Number spike/ m^2 as affected by the interaction between nitrogen levels and biofertilizer treatments in 2001/2002 and 2002/2003 seasons.

Nitrogen Levels (kg/fad)	Biofertilizer treatment Control	Cerealin	Nitrobin	Microbin	Rizobacteren
			2001/ 2002		
0	354.9ef	339.8f	382.4e	358.5ef	373.3ef
30	464.8d	475.6d	460.8d	454.8d	463.8d
45	542.9c	606.4a	583.8ab	553.4bc	568.4bc
			2002/2003		
0	253.8k	305.4j	355.5hi	307.9ij	332.6ij
30	393.5gh	459.4ef	433.9efg	417.9fg	428.1efg
45	471.0de	578.3a	562.5ab	510.3cd	529.1bc

Means within the same season designated by the same letter are not significantly different at 5 % level according to Duncan's Multiple Range Test.

B. 3. Spike length:

In both season, the results in Table 5 showed insignificant differences in spike length between the two cultivars where Giza 123 gave longer spike than Giza 2000.

Concerning the effect of Nitrogen levels, the results showed highly significant differences in both seasons. In general, 45 Kg N/fad gave the longest spikes followed by 30 Kg N / fad. and the control.

The increases in spike length with increasing nitrogen may be attributed to the role of nitrogen in promoting the vegetative growth and meristimic activity during growth. Such finding agree with those of Kortam (1995), Toaima *et al.* (2000), El–Hag (2001) and Megahed and Samia Mohamed(2002).

Table 9: Overall mean values of Spike length (cm) as affected by the interaction between cultivars and biofertilizers in 2001/2002 and 2002/2003 seasons.

Cultivars	Control	Biofertilizer treatment Cerealin	Nitrobin	Microbin	Rizobacteren
		2001 / 2002			
Giza 123	5.96 d	6.35 bc	6.62 ab	6.27 cd	6.71 a
Giza 2000	6.12 cd	6.38 abc	6.43 abc	6.39 abc	6.23 cd
		2002 / 203			
Giza 123	5.68d	6.05bc	6.32ab	5.96cd	6.41a
Giza 2000	5.82 cd	6.11abc	6.25 abc	6.10abc	5.93cd

Means within the same season designated by the same letter are not significantly different at 5 % level according to Duncan ' s Multiple Range Test.

Regarding biofertilizers, the data showed highly significant differences in spike length as compared with control which gave the shortest spikes (Table 5). The mode of action of the biofertilizer may be due to its exertion on some growth regulators which promote cell division and elongation; and resulted in longer spike. These results are in harmony with those of Hamed (1998) , Sharief *et al.* (1998), El-Kalla *et al* (2002), Abd El-Maksoud (2002) and Farag (2003).

Table 9: showed the interaction effect between cultivars and biofertilizers. Data showed that the longest spike were obtained from Giza 123 using Rizobacteren and Nitrobin.

The interaction between Nitrogen levels and Biofertilizers treatments had significant effect on this trait in both seasons. Data in Table 10 showed that the longest spikes were obtained at 45 Kg N and all biofertilizer sources. The shortest ones were obtained at control (noninoculated and 0 Kg N) in both seasons.

Data in Table 11 showed that the longest spikes for Giza 123 were obtained at 45 Kg N / fad. and Microbin (7.38 cm) while for Giza 2000 were at 45 Kg N / fad. and Nitrobin (7.05 cm) in the first season. In the second season the trend was similar to those of the first season.

B.4. Number of grains / spike:

Data in Table 12 sowed that insignificant difference between cultivars for this trait in both seasons.

Regarding the effect of Nitrogen levels, results showed highly significant differences in number of grains/spikes. In general, 45 kg N/fad gave number of grains/spike outnumbered the others and ranked first and it followed by 30 kg N/fad. The overall mean values were 43.18 , 49.32 and 53.97 in the first season, and 37.18 , 43.29 and 48.06 in the second one for the control, 30 Kg and 45 Kg N/fad, respectively. It is clear that nitrogen promote growth and raise sink capacity and size which induced more grains /

spike. These results agree with those of El-Hindi *et al.*(1998), Amer (1999) Abd El-Maksoud *et al* (2002), Mowafy (2002) and Farag (2003

Concerning the effect of biofertilizer on this criterion, results showed that inoculation with Rizobacteren resulted in number of grains/spike outnumbered others sources. Applying biofertilizer clearly improved growth increased photosynthetic rate and assimilation products that affect kernel formation. These results are in agreement with those of Attalah and El-Karamity (1997), Sharief *et al.* (1998), Said (1998), Abd El-Maksoud (2002)and El- Kalla *et al* (2002).

Table 10: Overall mean values of Spike length (cm) as affected by interaction between nitrogen levels and biofertilizers in 2001/2002 and 2002/2003 seasons.

Nitrogen Level (Kg / fad.)	Biofertilizers treatments				
	Control	Cerealin	Nitrobin	Microbin	Rizobacteren
			2001/ 2002		
0	5.3 h	5.8 fg	5.8 fg	5.5 gh	5.7 g
30	6.1 ef	6.3 de	6.7 cd	6.3 de	6.8 bc
45	6.7 cd	7.0 abc	7.1 ab	7.2 a	6.9 abc
			2002 / 2003		
0	5.0 h	5.5 fg	5.6 fg	5.2 gh	5.4 g
30	5.8 ef	6.0 de	6.4 cd	6.0 de	6.5 bc
45	6.4 cd	6.7 abc	6.8 ab	6.9 a	6.6 abc

Means within the same season for each factor designated by the same letter are not significantly different at 5 % level according to Duncan ' s Multiple Range Test.

Table 11: Overall mean values of Spike length (cm) as affected by the interaction among cultivars, nitrogen levels and biofertilizers in 2001/2002 and 2002/2003seasons.

Cultivars	Nitrogen levels (Kg /fad)	Biofertilizers treatment				
		Control	Cerealin	Nitrobin	Microbin	Rizobacteren
			2001 /2002			
Giza 123	0	5.10 L	5.65h-k	6.00f-i	5.43 kl	5.90g-j
	30	6.08f-h	6.23e-g	6.73b-d	6.00f-i	7.15ab
	45	6.73b-d	7.18ab	7.15ab	7.38a	7.08ab
Giza 2000	0	5.43kl	6.00f-i	5.68h-k	5.58i-k	5.50j-l
	30	6.20e-g	6.33d-g	6.58c-e	6.58c-e	6.64c-f
	45	6.75b-d	6.83bc	7.05ab	7.03ab	6.78b-d
			2002/2003			
Giza123	0	4.88m	5.35i-l	5.70g-j	5.13l-m	5.60h-k
	30	5.75g-i	5.93f-h	6.43c-e	5.70g-j	6.85a-c
	45	6.43c-e	6.89ab	6.85ac	7.08a	6.78a-c
Giza2000	0	5.13lm	5.73g-i	5.43i-l	5.28j-m	5.20k-m
	30	5.90f-h	6.08e-g	6.28d-f	6.28d-f	6.13d-g
	45	6.45b-e	6.53b-d	6.75a-c	6.73a-c	6.48b-e

Means designated by the same letter are not significantly different at 5 % level according to Duncan ' s Multiple Range Test

Table (12): Overall mean values of number of grain/spike, 1000-grain wt,biological yield of two barley cultivars as affected by Nitrogen levels and biofertilizers and their interactions in 2001/2002 and 2002/2003 seasons

Variable	No.grain/spike		1000-grain wt		biological yield	
Year	01/02	02/03	01/02	02/03	01/02	02/03
Cultivars						
Giza 123	48.42	42.43	55.26a	50.20a	6.06a	5.77a
Giza 2000	49.23	43.26	51.29b	46.28b	5.17b	4.87b
F.test	NS	NS	**	**	*	*
Nitrogen levels (N) kg/fad.						
0	43.18c	37.18c	54.05a	49.03a	3.63c	3.32c
30	49.32b	43.29b	53.71a	48.64a	6.17b	4.87b
45	53.97a	48.06a	52.06b	47.05b	7.06a	6.79a
F.test	**	**	**	**	**	**
Biofertilizer (B)						
Control	46.71d	40.71c	52.35c	47.19c	5.29c	4.97c
Cerealin	49.10bc	43.32ab	53.01b	48.07a	5.72a	5.45a
Nitrobin	49.67ab	43.87a	53.76a	48.76a	5.82a	5.51a
Microbin	48.53c	42.53b	53.42ab	48.57ab	5.55b	5.29b
Rizobacteren	50.13a	43.79a	53.81a	48.80a	5.70ab	5.52ab
F.test	**	**	**	**	**	*
Interactions						
CN	NS	NS	**	**	NS	NS
CB	NS	NS	NS	NS	NS	NS
NB	*	NS	**	**	NS	NS
CNB	NS	NS	NS	NS	NS	NS

***,** and NS indicate P < 0.05, p< 0.01 and not significant, respectively.**
Means designated by the same letter are not significantly different at 5 % level according to Duncan ' s Multiple Range Test.
Means designated by the same letter are not significantly different at 5 % level according to Duncan ' s Multiple Range Test

The interaction effect between Nitrogen levels and Biofertilizers were significant in the first season. Data in table (13) showed that the highest number of grains / spike were obtained at 45 Kg N + Rizobacteren (56.1) and the lowest number (40.5) at 0 nitrogen + Control.

B.5. 1000- kernels weight

Results in Table 12 showed highly significant differences between the two cultivars for this trait in both seasons. where Giza 123 gave heavier grains than Giza 2000. These results are in harmony with those of Allam (1997) , Oscarsson *et al* (1998) and Afifi (1999) .

Regarding the effect of nitrogen levels on this trait, the results showed highly significant differences among them, where 45 Kg N / fad gave the lightest grains, while 0 nitrogen gave the heaviest ones. This may be attributed to more number of grains / spike that affect grain filling and decrease grain weight and size. These results are in good agreement with those of Weston (1993), Sharshar *et al* (1995), Said (1998), Megahed and Samia, Mohammed(2001). and El-Sharaawy (2003) . On the other hand, these results disagree with those of El-Hindi (1998) and Sobh et al (2000)

Concerning biofertilizers, the results showed that Rizobacteren and Microbin exerted the heaviest grain weight followed by Nitrobin and Cerealin (Table 12). The favorable effect of biofertilizer could be attributed to the improvement of growth and sink input. Moreover, it could be also due to the role of nitrogen in promotion of phytohormone formation and translocation to the plant. These results agreed with those of Sharief *et al* (1998), Mehasen (1999), Mashhoor *et al* (2001) and Khafagy (2003)

Table 13: Overall mean values of number of grains / spike as affected by interaction between cultivars and biofertilizers in 2001/2002 season.

Nitrogen levels) (Kg / fad.	Biofertilizer treatments				
	Control	Cerealin	Nitrobin	Microbin	Rizobacteren
0	40.5 h	43.3 g	44.7f g	43.6 g	43.9 g
30	47.1 ef	50.0 cd	50.4 cd	48.7 de	50.4 cd
45	52.5 bc	54.1 ab	53.9 ab	53.3 b	56.1 a

Means designated by the same letter are not significantly ifferent at 5 % level according to Duncan ' s Multiple Range Test.

The interaction between cultivars and nitrogen levels had highly significant effect on this trait. Data in Table (14) showed that the heaviest grains were obtained

Table 14: overall mean values of 1000 kernels weight(g) as affected by the interaction between cultivars and nitrogen levels in 2001/2002 and 2002/2003 seasons.

Cultivars	Nitrogen levels (Kg/fad.)					
	0	30	45	0	30	45
	2001 / 2002			2002 / 2003		
Giza 123	55.9a	54.9b	54.8b	50.9a	49.9ab	49.79b
Giza2000	52.2c	52.4c	49.3d	47.2c	47.37c	44.36d

Means within the same season designated by the same letter are not significantly different at 5 % level according to Duncan's Multiple Range Test.

at 0 Kg N /fad followed by 30 and 45 Kg N / fad. for Giza 123. On the other hand, Giza 2000 recorded the heaviest grains either at 0 or 30 Kg N / fad. with insignificant differences followed by 45 Kg N / fad. in both seasons.

The interaction effect between nitrogen levels and biofertilizers were highly significant. Data in table (15) showed that the heaviest grains were obtained at 0 Kg N / fad and at 30 Kg N / fad + biofertilizers in both seasons.

B.6. Biological yield (t / fad.):

Results showed significant differences between cultivars, Table 12, where Giza 123 outyielded Giza 2000 (6.06 and 5.17 t / fad) in the first season and (5.77 and 4.87 t / fad.) in the second one, respectively. These results agree with those of Noaman *et al* (1997), El –Hag (2001) and Muostafa (2002).

Regarding nitrogen levels results showed significant differences among them. In general, increasing nitrogen levels from 0 to 45 Kg N/fad. caused more vigorous growth , plant height, number of grains / spike and number of spikes / m^2 and in turn, increased biological yield. In this respect many workers reported that nitrogen fertilization encouraged the production of biological yield per unit area. These results agree with those of El-sayed *et al* (1991), Basha *and Bana* (1994), Kortam (1995), Amer (1999) and Megahed and Samia Mohammed(2002).

Table (15):Overall mean values of 1000 grain weight (g) as affected by the interaction between biofertilizers and nitrogen levels in 2001/2002 and 2002/2003 seasons.

Nitrogen levels Kg / fad.	Control	Cerealin	Biofertilizers Nitrobin	Microbin	Rizobacteren
			2001 / 2002		
0	54.05 ab	53.21 bc	54.58 a	54.17 ab	54.25 ab
30	52.03 d	54.13 ab	54.01 ab	53.72 ab	54.63 a
45	50.69 e	51.70 de	52.68 cd	52.38 cd	52.56cd
			2002 / 2003		
0	48.72bc	48.46cd	49.83a	49.17abc	49.25abc
30	46.89ef	48.92abc	48.78bc	49.16abc	49.63ab
45	45.96f	46.83ef	47.67de	47.38e	47.52e

Means within the same season designated by the same letter are not significantly different at 5 % level according to Duncan ' s Multiple Range Test.

Concerning biofertilizers, results showed significant effect on biological yield where, Nitrobin, Cerealin and Rizobacteren gave the highest yield and ranked first with insignificant differences followed by Microbin, while, noninoculation treatment ranked last in both seasons. The previous results may be attributed to the effect of biofertilizers on improving the previous components, viz., number of spikes / m^2, number of grains / spike, and 1000- grains weight. These results are in accordance with those of Hamed (1998), Mehasen (1999) Megahed and Samia Mohamed (2001) and Farag (2003).

The interactions among cultivars, nitrogen levels and biofertilizers had insignificant effect on this trait in both season.

B.7. Grain yield (ard / fad.) :

Data in Table 16 showed that Giza 123 significantly outyielded Giza 2000 (15.76 and 13.63 ard /fad. in the first season and 14.53 and 12.19 ard/ fad. in the second one). Such finding could be attributed to yield components viz. number of spikes / m^2, 1000- grains weight. and the related characteristic of each cultivar. These results are in harmony with those of Allam (1997), Abo- El-Enin *et al* (1998), Afifi (1999), and El-Hag (2001) and Moustafa (2002) .

Table 16: overall mean values of grain yield, straw yield and harvest index of two barley cultivars as affected by nitrogen levels and biofertilizers and their interactions in 2001/2002 and 2002/2003 seasons

Variable	grain yield		straw yield		harvest index %	
Year	2001/02	2002/03	01/02	02/03	01/02	02/03
Cultivar						
Giza 123	15.76	14.53	4.17	4.03	30.38	29.11
Giza 2000	13.63	12.19	3.54	3.41	30.88	28.87
F.test	*	*	*	*	NS	NS
Nitrogen levels kg/fad.(N)						
0	7.80c	6.39c	2.68c	2.55c	26.20c	23.24c
30	16.11b	14.94b	4.23b	4.07b	31.35b	30.56b
45	20.16a	18.76a	4.64c	4.54a	34.34a	33.16a
F.test	**	**	**	**	**	**
biofertilizer (B)						
Control	14.08d	12.83d	3.60b	3.43b	31.50a	30.04a
Cerealin	15.08b	13.69ab	3.91a	3.80a	30.79ab	28.93ab
Nitrobin	15.59a	13.89a	3.94a	3.84a	31.26a	29.02ab
Microbin	14.13d	12.89cd	3.86a	3.73a	29.59c	28.23b
Rizobacteren	14.58c	13.41bc	3.95a	3.81a	30.01bc	28.72b
F.test	**	**	**	**	**	*
Interactions						
CN	NS	NS	NS	NS	NS	NS
CB	NS	NS	NS	NS	NS	NS
NB	*	*	NS	NS	**	NS
CNB	NS	NS	NS	NS	NS	NS

***,** and NS indicate P < 0.05, p< 0.01 and not significant, respectively.**
Means designated by the same letter are not significantly different at 5 % level according to Duncan ' s Multiple Range Test

Regarding nitrogen levels, the results showed significant increases in grain yield in both seasons. In general 45 Kg N / fad outyielded the others and followed by 30 kg N /fad. and control. The increases in grain yield could be due to the increases in yield components viz. number of grains / spike, and number of spikes / m^2 ...etc.. Such finding agree with those of Sharshar *et al.*(2000), Howard *et al* (2002), Abd El-Maksoud (2002), Mohammed (2002) , Munir (2002) , Potil and Itnal (2002) and El- Shaarawy (2003).

Concerning the effect of biofertilizers on this trait, the data showed that Nitrobin and Cerealin gave the highest grain yield followed by Rizobacteren, whereas the control gave the lowest yield. The increases in grain yield by inoculation may be attributed to the increases in yield components as in case of nitrogen fertilization. It could be also explained on the basic that iofertilizer could increase the availability of some nutrients such as N.P.K. and growth regulators extraction, and raising sink efficiency. These results agree with those of Sudhir *et al* (1998), Hamed (1998), Sharshar *et al* (2000), Ahmed (2001), Ghallab and Salem (2001), Mashhoor *et al* (2001), El- Kalla *et al* (2002), Farag (2003) and Khafagy (2003).

The interaction effect between nitrogen levels and biofertilizers were highly significant on this trait. Data in Table 17 indicated that Nitrobin, Cerealin and Rizobacteren + 45 Kg N / fad, gave the highest grain yield with insignificant differences among them, while control (0 nitrogen) and uninoculated treatments gave the lowest yield values.

Table 17: Overall mean grain yield (ard/fad.) as affected by the interaction between nitrogen levels and biofertilizers in 2001/2002 and 2002/2003 seasons.

Nitrogen level Kg / fad.	Biofertilizers Control	Cerealin	Nitrobin	Microbin	Rizobacteren
			2001 / 2002		
0	7.32h	8.14h	8.14h	7.50h	7.91h
30	15.37fg	16.63e	17.76d	14.95g	15.83f
45	19.55c	20.46ab	20.87a	19.93bc	20.00b
			2002 / 2003		
0	6.03f	6.59f	6.43f	6.18f	6.72f
30	14.17e	15.19d	16.23c	14.37e	14.76de
45	18.30b	19.30a	19.04ab	18.39b	18.75ab

Means within the same season designated by the same letter are not significantly different at 5 % level according to Duncan ' s Multiple Range Test.

B.8. Straw yield (t / fad.):

Results in Table 16 revealed that Giza 123 outyielded Giza 2000 in straw yield in both seasons. The mean values were 4.17 and 3.54 t / fad. in the first season and 4.03 and 3.4 t / fad. in the second one for Giza 123 and Giza 2000, respectively.

Regarding nitrogen levels, the results showed highly significant effects where the highest yield obtained at 45 kg N/fad., while the lowest ones was at 0 N in both seasons. The increases in straw yield due to nitrogen application may be attributed to the increases in plant height and number of tillers/m^2. These results agree with those of Hassanein and Hassouna (1997), Amer (1999), Sharshar *et al.* (2000) and Sobh *et al* (2000).

Concerning biofertilizers, the data showed insignificant differences existed among them. with the control gave the lowest straw yield in both seasons. This increases due to biofertilizers may be attributed to their effect on growth parameters, i.e. plant height and number of tillers/m^2. These results are in harmony with those of Atta Alah and El-Karamity (1997), Sharief *et al* (1998), Hamed (1998), Megahed and Samia Mohamed(2001) El-Kalla *et al* (2002), Farag (2003) and Khafagy (2003)

B.10. Harvest index (%):

Data presented in Table 16 showed insignificant differences existed between the two cultivars for this criterion in both seasons.

Concerning the effect of nitrogen levels, the results showed highly significant differences among them, where 45 Kg N / fad. gave the highest index followed by 30 Kg N / fad. in both seasons. These results are in harmony with those of Gharib (2001),Abd El-Maksoud (2002) and Farag (2003).

Regarding biofertilizers, the data showed highly significant effects in the first and significant in the second seasons, respectively, where control, Nitrobin and Cerealin gave the highest percentages and ranked first followed by Rizobacteren and Microbin. These results are in accordance with those of Said (1998), Hamed (1998), Abd El-Maksoud (2002) and Farag (2003).

The interaction data in Table 18 showed that Cerealin, Control, Nitrobin and Microbin + 45 Kg N / fad. gave the highest index, while Rizobacteren gave the lowest index.

Table 18: Overall mean harvest index (%) as affected by the interaction between nitrogen levels and biofertilizers in 2001/2002 seasons.

Nitrogen levels Kg / fad.	Biofertilizers treatments				
	Control	Nitrobin	Cerealin	Microbin	Rizobacteren
0	28.18f	25.77g	25.80g	24.91g	26.35g
30	31.49cd	31.86cd	33.04bc	29.66ef	30.07de
45	34.82a	34.73a	34.94a	34.21ab	32.98bc

Means designated by the same letter are not significantly different at 5 % level according to Duncan ' s Multiple Range Test

C. Grain Quality

C.1.Crude protein %:

The results of analysis of variance indicated insignificant differences in crude protein between Giza 123 and Giza 2000 in both seasons, (Table 19).

Concerning nitrogen levels, the results showed highly significant differences among them in both seasons. In general, increasing nitrogen levels increased protein %, where 45 kg N / fad gave the highest percentage followed by 30 kg N/fad., and control. These results are in accordance with those of Bulman and Smith (1993), Weston *et al.* (1993), El-Hindi *et al* (1998), Sobh *et al.* (2000), El-hag (2001) and Farag (2003).

Regarding biofertilizers, the data showed significant increases in grain protein, where Nitrobin and Rizobacteren gave the highest percentages followed by Cerealin and Microbin, and Control at last. These results are in harmony with those of Ahmed (2001), El-Kalla *et al.* (2002), Mohamed (2002) and Farag (2003).

The interactions among cultivars, nitrogen levels and biofertilizers had insignificant effect on this trait in both seasons.

C.2. Protein yield (Kg/fad.)

Table (19) showed the overall mean protein yield of the two barley cultivars as affected by nitrogen levels, biofertilizers and their interactions in 2001 / 2002 and 2002 / 2003 seasons.

Results in Table 19 showed significant differences in protein yield between cultivars, where Giza 123 outyielded Giza 2000 in both seasons. Concerning the effect of nitrogen levels, the results showed that 45 Kg N/fad gave the highest protein yield followed by 30 Kg N / fad. and 0 Kg N / fad. In general, the trend of these results are similar to those of protein content and grain yield. These results are in accordance with those obtained by El- Hag (2001).

Table 19: overall mean grain quality of two barley cultivars as affected by nitrogen levels and biofertilizers and their interactions in 2001/2002 and 2002/2003 seasons

Variable	protein %		protein yield	(kg/fad.)
Year	2001/2002	2002/2003	2001/2002	2002/2003
Cultivars (C)				
Giza 123	10.22	10.36	164.43	142.14
Giza 2000	10.14	10.40	145.89	123.32
F.test	NS	NS	NS	**
Nitrogen levels (N) kg/fad.(N)				
0	8.82c	9.31c	70.85c	54.34c
30	10.37b	10.54b	167.94b	145.31b
45	11.35a	11.31a	226.69a	198.54a
F.test	**	**	**	**
biofertilizer (B)				
Control	9.96c	10.25d	171.44c	159.94
Cerealin	10.20b	10.42b	183.53ab	167.55
Nitrobin	10.31a	10.47a	191.83a	167.89
Microbin	10.14b	10.33c	173.47c	158.86
Rizobacteren	10.29a	10.45ab	176.49bc	161.07
F.test	*	**	**	NS
Interactions				
CN	NS	NS	NS	NS
CB	NS	NS	NS	NS
NB	NS	NS	NS	NS
CNB	NS	NS	NS	NS

*,** and NS indicate $P < 0.05$, $p< 0.01$ and not significant, respectively.
Means designated by the same letter are not significantly different at 5 % level according to Duncan's Multiple Range Test

Regarding biofertilizers, results showed highly significant increases in protein yield in the first season and insignificant differences in the second one. where Nitrobin and Cerealin gave the highest protein yield while control gave the lowest one. In general, the trend of the results are similar to those of grain yield. These results agree with those of Hamed (1998).

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تأثير التسميد النيتروجيني والحيوي على صنفين من الشعير

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أجريت تجربتان حقليتان فى محطة البحوث الزراعية بسخا خلال موسمي ٢٠٠١/٢٠٠٢ و ٢٠٠٢/٢٠٠٣ وذلك لدراسة استجابة صنفين من الشعير (جيزة ١٢٣ وجيزة ٢٠٠٠) لكل من مستويات التسميد النيتروجيني (صفر ، ٣٠ و ٤٥ كجم نيتروجين /فدان) ومصادر مختلفة من التسميد الحيوى (غير معامل ، ميكروبين ، نيتروبين ، سيريالين وريزوبكترين).

استخدم في هذه الدراسة تصميم القطع المنشقة مرتين فى أربعة مكررات وتمت دراسة الصفات التالية: ميعاد طرد السنابل- ميعاد النضج- طول النبات - عدد السنابل فى المتر المربع- طول السنبلة- عدد حبوب السنبلة- وزن الـ١٠٠٠ حبة - المحصول البيولوجى (طن/فدان) - محصول الحبوب (إردب /فدان)- محصول القش (طن/فدان) - دليل الحصاد -نسبة البروتين فى الحبوب - محصول البروتين (كجم/فدان)ويمكن تلخيص النتائج المتحصل عليها كالآتي :-

١- تفوق الصنف جيزة ١٢٣ على الصنف جيزة ٢٠٠٠ فى معظم الصفات تحت الدراسة حيث أعطى أعلا القيم لكل من طول النبات، عدد السنابل فى المتر المربع، وزن الـ١٠٠٠ حبة - المحصول البيولوجي، محصول الحبوب، محصول القش-و البروتين .

٢-بصفة عامة وجد ان زيادة النتروجين من صفر الى ٤٥ كجم/فدان أدت الى زيادة معنوية فى كل الصفات تحت الدراسة ما عدا وزن ١٠٠٠ حبة.

٣-أوضحت النتائج أيضا ان التسميد الحيوى أدى الى زيادة كل من المحصول ومكوناته وفى نفس الوقت عمل على تحسين نوعية الشعير. وكانت اعلى القيم تم الحصول عليها عند تلقيح التقاوى بالنتروبين مقارنة بمصادر التسميد الحيوى الأخرى تحت الدراسة.

٤-يمكن التوصية بزراعة صنف أى من مصادر الشعير جيزة ١٢٣ مع التسميد بمعدل ٤٥ كجم نيتروجين/فدان مع استخدام التسميد الحيوى وذلك للحصول على افضل إنتاج من الشعير من حيث الكمية والنوعية.