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EFFECT OF SOWING DATE AND N FERTILIZATION ON YIELD AND ITS COMPONENTS OF TWO HULL-LESS BARLEY CULTIVARS

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ABSTRACT

Among the cultural practices, sowing date and fertilizer application are some of the limiting factors to achieve production potential of the crop. A two year field experiment was conducted at El-Kharga district in the New Valley during 2012/2013 and 2013/2014 seasons, respectively, to investigate the effect of two sowing dates (Nov, 20 and Dec. 20) and four N fertilizer levels (0, 30, 60 and 90 kg N fed^{-1}) on yield and its components of two hull-less barley cultivars (Giza 130 and Giza 135). Results showed that days to heading, plant height, days to maturity, yield components (spike length, number of grain $spike^{-1}$, spike kernel weight and 1000-kernel weight), and grain yield of barley were significantly affected by sowing date. Giza 130 sown on 20 Nov. produced the highest grain yield compared with sowing on 20 Dec. irrespective of the fertilizer used. Also, sowing at 20 Nov. gave the highest number of kernels $spike^{-1}$, 1000-kernel weight and biological yield with Giza 130. Grain yield and yield components of barley were also affected by N fertilizer levels. Days to heading, days to maturity, 1000-kernel weight, biological yield and grain yield increased with increasing nitrogen application level up to 90 kg N fed^{-1}. The interaction between sowing date and cultivar had a significant effect on all the studied traits except for days to maturity. However, the interaction effect of sowing date and N fertilizer indicated that the highest grain yield was obtained from the treatment of 20 Nov. sowing with 90 kg fed^{-1} N. Also, the interaction among sowing dates, cultivar and nitrogen fertilizer was significant for all traits, except for days of maturity. It can be concluded that 20 Nov. sowing date with 90 Kg N fed^{-1} might be sustainable approach for achieving the highest production of Giza 130 under the New Valley conditions in Upper Egypt.

Key words: *Hordeum vulgare L, sowing date, N fertilizer levels, grain yield, biological yield.*

1. INTRODUCTION

Barley (*Hordeum vulgare* L.) is the major cereal crop in many dry areas of the world and is vital for the livelihoods of many farmers. Barley is an annual cereal crop grown in environments ranging from the desert of the Middle East to the high elevation of Himalayas (Hayes *et al*., 2003). It is usually used as food for humans and feed for animals and poultry. The variety plays an important role for producing better yield and seed quality of barley. Different varieties respond differently for their genotypic characters, input requirement, growth process and the prevailing environment during growing season (Yesmin *et al*., 2014). Sowing date and fertilizer rate control the yield. Effect of sowing time and fertilizer levels on the yield of barley was tested under rainfed condition. The differences in yield of early and late sown crops may be due to favorable temperatures at different growth stages, which may increase photosynthetic rate. Heat stress during and after anthesis growth stages mainly affects assimilates availability,

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تأثير مواعيد الزراعة والتسميد النتروجينى على المحصول ومكوناته لصنفين من الشعير العارى

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ملخص

تعتبر العمليات الزراعية ومواعيد الزراعة والتسميد من العوامل الرئيسية المحددة للطاقة الانتاجية للمحاصيل. أجريت هذه الدراسة في منطقة الخارجة بالوادي الجديد خلال موسمى 2013/2012 و2014/2013 لدراسة تأثير ميعادى الزراعة (20 نوفمبر و20 ديسمبر) وأربعة معدلات من التسميد (بدون و30 و60 و90 كجم نيتروجين للفدان) على المحصول ومكوناته لصنفين من الشعير العاري (جيزة 130 وجيزة 135). أوضحت النتائج وجود تأثير معنوى لميعاد الزراعة على كل من عدد الأيام لطرد السنابل و عدد الأيام للنضج و عدد الحبوب بالسنبلة وطول النبات و محصول الحبوب. أعطى الصنف جيزة 130 أعلى قيمة لكل من عدد الحبوب بالسنبلة ووزن 1000 حبة والمحصول البيولوجى ومحصول الحبوب عند زراعته فى 20 نوفمبر مقارنة بميعاد الزراعة في 20 ديسمبر حيث كان محصول الحبوب أقل. أتضح أن زيادة معدل التسميد إلى 90 كجم نيتروجين فدان$^{-1}$ أدى إلى حدوث زيادة معنوية في كل من عدد الأيام لطرد السنابل و عدد الأيام للنضج وعدد الحبوب بالسنبلة ووزن 1000 حبة والمحصول البيولوجى ومحصول الحبوب. كان التفاعل بين ميعاد الزراعة والأصناف معنويا لكل الصفات التى درست ماعدا صفة عدد الأيام للنضج. بينما التفاعل الثلاثى بين ميعاد الزراعة والأصناف والتسميد الآزوتى كان معنويا لكل الصفات التى درست ماعدا صفات عدد الأيام لطرد السنابل وعدد الأيام للنضج و عدد الحبوب بالسنبلة. تساعد نتائج هذه الدراسة المنتج في تحديد العوامل الرئيسية التى يمكن بها تحسين انتاجية الشعير. حيث أعطى الصنف جيزة 130 أعلى انتاجية لمحصول الحبوب عند الزراعة فى 20 نوفمبر والتسميد بمعدل 90 كجم نيتروجين للفدان.

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translocation of photo-synthates to the grain and starch synthesis and deposition in the developing grain. **(**Modhej 2011). Among the nutrient elements, nitrogen plays a vital role in growth and development of the crop and also affects seed quality at its optimum level, although judicious dose of nitrogen elevates the yield and quality of barley seeds. The optimum dose of nitrogen varies from location to location (Yesmin *et al*., 2014). Hefni (1976) stated that grain yield of barley increased significantly as nitrogen rates increased up to 50 kg N fed^{-1} in Egypt,. Also, Turk *et al.,* (2003) indicated that the highest grain yield of barley under 120 Kg N ha^{-1} among N rates owing to highest number of spikes m^{-1} (537.5) and the number of grains spike $^{-1}$ (56.3) of barley than the control. Misra *et al.,* (1980) stated that increasing N up to the level of 60 kg N ha^{-1} resulted in a significant increase in straw yield of barley. Towfelis (1989) found that increasing nitrogen levels up to 60 kg fed^{-1} led to progressive increase in the number of spikes m^{-2}, grain yield and straw yield, while harvest index decreased with increasing N application. Orabi *et al*. (1998) studied the effect of nitrogen fertilization on barley under the New Valley conditions. They pointed out that increasing nitrogen level up to 178.5 kgN ha^{-1} caused significant increase in plant height, 1000 kernel weight, biological yield, straw yield and grain yield. Treated barley plants by 178.5 kg N ha^{-1} with weekly irrigation was considered the best combination for barley production under the New Valley conditions. Many research workers indicated that early planting increased the yield attributes and yield of different crops than late planting in different climatic conditions (Abdur *et al*., 2010). Unfavorable air temperature during grain filling is considered the major factor reducing barley production in Middle and Upper Egypt. Also interesting of barley response to environmental stresses has been increased in recent years because severe losses that result from climate changes and high concentrations of toxic elements (Lewis and Christiansen 1981, and Blum, 1985). The present study was conducted to determine the optimal sowing date and N fertilizer application for two hull-less barley cultivars for yield and its components under the New Valley conditions.

2. MATERIALS AND METHODS

The present study was carried out at the Experimental Farm of El-Kharga Research Station, the New Valley Governorate, Egypt, during the two successive seasons of 2012/2013 and 2013/2014.

Two sowing dates (20^{th} Nov. and 20^{th} Dec.), four nitrogen fertilizer levels (0, 30, 60 and 90 Kg N fed^{-1}) and two hull-less barley cultivars (Giza 130 and Giza 135) were used.

The experimental design was a split-split plot in a randomized complete block arrangement with three replications. The main plots were assigned to sowing dates, while the sub plots were assigned to cultivars and sub-sub plots were assigned to nitrogen fertilizer treatments. The plot size (experimental unit) was 4.2 m^2 (6 rows x 0.2 m x 3.5 m). Sowing was done by Drill method at the rate of 50 Kg fed^{-1}. Phosphorous fertilizer was applied during seedbed preparation at the rate of 60 Kg P_2O_5 fed^{-1} in the form of super phosphate (15.5% P_2O_5). Potassium fertilizer was applied at the rate of 24 Kg K_2O fed^{-1} in the form of potassium sulphate (48% K_2O) in two equal doses, the first dose was applied during seedbed preparation, while the second one was applied at 30 days after sowing. Nitrogen fertilizer was applied in the form of ammonium nitrate (33.5%) in three equal doses; the first dose was at sowing and the other two doses were applied at 21 and 45 days after sowing.

The other cultural practices were carried out according to the barley production practices followed at the New Valley, Egypt. The following growth and yield traits were recorded; days to heading, days to physiological maturity, plant height, spike length, number of kernels $spike^{-1}$, spike kernel weight, 1000-kernel weight, biological yield, grain yield, straw yield and

harvest index. The data were analyzed according to split-split-plot design. Standard analysis of variance using Least Significant Differences (LSD) was performed to estimate the significant differences among treatments (Steel and Torrie, 1980). Representative soil samples were taken from El-Kharga in 2012/13 and 2013/14 seasons before planting and were chemically and mechanically analyzed (Table 1). The average temperature and relative humidity were recorded during the two growing seasons as presented in Table (2).

days to heading was 64.7, 67.8, 70.1 and 71.2 days in the 1st season and 64.3, 66.8, 69.1 and 70.8 days in the 2nd season with 0, 30, 60 and 90 kg N fed^{-1}, respectively. The increase in the number of days to heading due to nitrogen fertilizer may be attributed to the retarding effect of the nitrogen element on the transition of the growing point from vegetative to floral stage. These results are in harmony with those of Mohamed (2009). Maximum number of days to heading (71.5 and 73.2 days) was from Giza 130 with 90 kg N fed^{-1} fertilizer in both seasons, respectively.

Table (1): Soil chemical and mechanical analyses at El-Kharga, the New Valley Governorate in 2012/013 and 2013/014 seasons.

El-Kharg	Chemical analysis			Mechanical analysis							
	ppm			pH	EC	$CaCo_3$	Clay	Silt	Fine	Coarse	Texture
	N	P	K		Dsm^{-1}	%	%	%	Sand%	Sand %	
1st season	22.0	11.0	210	7.6	1.46	2.00	18.9	10.6	70.5	23.5	Sandy loam
2^{sd} season	20.0	10.0	200	7.7	1.55	3.80	18.0	12.5	69.5	25.0	Sandy loam

Table (2): Means of maximum and minimum temperature and relative humidity at El-Kharga, the New Valley Governorate in 2012/2013 and 013/2014 seasons.

Date Nov: April	El-Kharga					
	2012/2013			2013/2014		
	Max	Min	RH%	Max	Min	RH%
Mean	27.9	12.2	39.0	28.5	12.5	39.2

3. RESULTS AND DISCUSSION

3.1. Vegetative Growth

3.1.1. Days to heading

Results concerning days to heading are presented in Table (3). Days to heading were significantly ($p \leq 0.05$) affected by sowing date, cultivar and N levels in both season and SxG interaction in the 2nd one Table (3) showed That sowing date on 20th Nov. gave maximum days to heading, while sowing date on 20th Dec. exhibited minimum days to heading. Days to heading varied from 61.0 to 73.3 days at the 1st season and from 55.0 to 74.7 days at the 2nd season. Also, the results revealed that heading for Giza 135 was earlier than Giza 130 across the two seasons. The average number of

3.1.2. Days to physiological maturity

Results presented in Table (4) indicated that different sowing dates, cultivars and N levels had a significant effect on this treat in both seasons, except for sowing date in the 2nd season.

Days to maturity varied from 95.0 to 113.3 the days at the 1st season and from 94.3 to 112.0 days at the 2nd season. Also, the results revealed that maturity for Giza 135 was earlier than Giza 130 across the two seasons. The average number of days to maturity was 97.3, 102.8, 105.8 and 110.0 days in the 1st season and 100.0, 103.8, 106.2 and 108.7 days in the 2nd season with 0, 30, 60 and 90 kg N fed^{-1}, respectively. Application of 90 kg N fed^{-1} gave the highest number of days to maturity (110.0

Table (3): Mean number of days to heading as influenced by sowing date, nitrogen level, cultivars and their interactions in both seasons.

Sowing date	Cultivars	2012/2013					2013/2014				
		N levels (kg N fed^{-1})				Mean SxG	N levels (kg N fed^{-1})				Mean SxG
		0	30	60	90		0	30	60	90	
20/11	G130	68.0	71.0	73.3	72.3	71.2	69.3	71.7	73.7	74.7	72.35
	G135	64.7	67.3	70.7	73.0	68.9	67.0	69.3	72.0	74.3	70.65
20/12	G130	65.0	67.7	69.7	70.7	68.3	65.7	68.3	70.3	72.0	69.08
	G135	61.0	65.0	66.7	68.7	65.4	55.0	58.0	60.3	62.0	58.83
Mean NxG	G130	66.5	69.3	71.5	71.5		66.3	68.8	71.2	73.2	
	G135	62.8	66.2	68.7	70.8		62.2	64.80	67.0	68.3	
	Mean N	64.7	67.8	70.1	71.2		64.3	66.8	69.1	70.8	

Sowing date : S
Cultivars effect : S
LSD N = 1.356
LSD NxG = NS
LSD SxG =NS
LSD SxNxG =NS

Sowing date : S
Cultivars effect : S
LSD N = 0.760
LSD NxG = NS
LSD SxG =1.454
LSD SxNxG =NS

Table (4): Mean number of days to physiological maturity as influenced by sowing date, nitrogen level, cultivars and their interactions in both seasons.

Sowing date	Cultivars	2012/2013					2013/2014				
		N levels (kg N fed^{-1})				Mean SxG	N levels (kg N fed^{-1})				Mean SxG
		0	30	60	90		0	30	60	90	
20/11	G130	100.0	107.3	108.7	113.3	107.3	102.7	105.7	108.7	112.0	107.3
	G135	95.7	101.7	106.0	111.0	103.6	99.7	102.3	104.3	105.7	103.0
20/12	G130	98.7	103.7	107.0	109.0	104.6	103.3	106.0	107.7	110.0	106.8
	G135	95.0	98.3	101.7	106.7	100.4	94.3	101.3	104.0	107.0	101.7
Mean NxG	G130	99.3	105.5	107.8	111.2		103.0	105.8	108.2	111.0	
	G135	95.3	100.0	103.8	108.8		97.0	101.8	104.2	106.3	
	Mean N	97.3	102.8	105.8	110.0		100.0	103.8	106.2	108.7	

Sowing date : S
Cultivars effect : S
LSD N = 1.173
LSD NxG = NS
LSD SxG = NS
LSD SxNxG = NS

Sowing date : NS
Cultivars effect : S
LSD N = 1.062
LSD NxG = NS
LSD SxG = NS
LSD SxNxG = 2.125

and 108.7days) in both seasons, respectively. Moreover, all interactions affected days to maturity in both seasons. These results are in harmony with those of Mohamed (2009).

3.1.3. Plant height

Results presented in Table (5) showed that plant height was significantly affected by sowing date and N level in the 1st season, while all the studied factors and their interactions had a significant effect in the 2nd season. Sowing on November 20 produced taller plants. This could be due to long life time of the plant which gave a maximum vegetative growth. plant height varied from

Table (5): Mean plant height (cm) as influenced by sowing date, nitrogen level, cultivars and their interactions in both seasons.

Sowing date	Cultivars	2012/2013					2013/2014				
		N levels (kg N fed^{-1})				Mean SxG	N levels (kg N fed^{-1})				Mean SxG
		0	30	60	90		0	30	60	90	
20/11	G130	58.0	62.0	64.3	65.7	62. 5	57.7	60.0	61.0	62.0	60.2
	G135	58.7	61.0	63.3	65.7	62.2	52.7	56.0	59.7	61.3	57.4
20/12	G130	57.0	59.3	61.3	60.7	59.6	57.7	58.7	60.7	62.7	60.0
	G135	57.0	58.7	61.0	64.3	60.3	57.3	58.7	61.0	63.0	60.0
Mean NxG	G130	57.5	60.7	62.8	63.2		57.7	59.4	60.9	62.4	
	G135	57.8	59.8	62.2	65.0		55.0	57.4	60.4	62.2	
	Mean N	57.7	60.3	62.5	64.1		56.4	58.4	60.6	62.3	
		Sowing date : S **Cultivars effect :NS** **LSD N = 2.216** **LSD NxG = NS** **LSD SxG = NS** **LSD SxNxG = NS**					**Sowing date : S** **Cultivars effect : S** **LSD N = 0.461** **LSD NxG = 0.652** **LSD SxG = 1.644** **LSD SxNxG = 0.922**				

57.0 to 65.7cm at the 1st season and from 57.3 to 63.0 days at the 2nd season. Giza 130 recorded a maximum plant height in both seasons compared to Giza 135. Plant height was increased by increasing N levels and this was clear in the 2nd season. The average plant height was 57.7, 60.3, 62.5 and 64.1 cm in the 1st season and 56.4, 58.4, 60.6 and 62.3 cm in the 2nd season with 0, 30, 60 and 90 kg N fed^{-1}, respectively. These results suggested that early sowing with N fertilizer application might have improved the vegetative growth of the crop. These finding are in agreement with those reported by of Abdur *et al*. (2010).

3.1.4. Spike length

Results presented in Table (6) indicated that different sowing dates, cultivars and N levels had a significant effect on spike length in both seasons, except for sowing date in the 2nd season. Spike length varied from 3.5 to 6.9 cm at the 1st season and from 2.9 to 5.4 cm at the 2nd season. Giza 135 produced the longest spike than that of Giza 130 in the1st season but Giza 130 gave the longest spike in the 2nd season. The average of Spike length was 4.4, 5.4, 5.9 and 6.3 cm in the 1st season and 3.4, 4.0, 4.4 and 4.8 cm in the 2nd season with 0, 30, 60 and 90 kg N fed^{-1}, respectively. Application of 90 kg N fed^{-1} gave the highest spike length (6.3 and 4.8 cm) in the 1st and the 2nd seasons, respectively. On the other hand, all interactions showed insignificant effect with the exception of SxG and SxGxN in the 2nd season. These results are in harmony with those of Mohamed (2009).

3.2.Yield and its components

3.2.1. Number of kernels spike^{-1}

Results in Table (7) revealed that the number of kernels spike^{-1} was significantly ($p\leq$ 0.05) affected by sowing date, cultivars and N levels in the 1st season. On the other hand, this effect was by N level in the 2nd season. All interactions showed insignificant effect with the exception of GxN and SxN in the 1st season also SxG and SxGxN in the 2nd season. The early sowing date produced higher number of grains spike^{-1}. The average of grains spike^{-1} varied from 23.0 to 44.3 in the 1st season and from 19.7 to 34.0 in the2nd season. This could be attributed to the different genetic systems of the studied barley cultivars. Results showed that barley

Table (6): Mean spike length (cm) as influenced by sowing date, nitrogen level, cultivars and their interactions in both seasons.

Sowing date	Cultivars	2012/2013					2013/2014				
		N levels (kg N fed^{-1})				Mean SxG	N levels (kg N fed^{-1})				Mean SxG
		0	30	60	90		0	30	60	90	
20/11	G130	4.3	5.3	6.0	6.4	5.5	3.9	4.5	5.0	5.4	4.7
	G135	5.2	6.0	6.5	6.9	6.2	2.9	3.4	3.7	4.0	3.5
20/12	G130	3.5	4.6	5.1	5.5	4.7	3.3	3.6	4.0	4.3	3.8
	G135	4.3	5.6	5.9	6.3	5.5	3.5	4.4	4.7	5.3	4.5
Mean NxG	G130	3.9	4.9	5.5	5.9		3.6	4.0	4.5	4.9	
	G135	4.8	5.8	6.2	6.6		3.2	3.9	4.2	4.7	
	Mean N	4.4	5.4	5.9	6.3		3.4	4.0	4.4	4.8	

Sowing date : S
Cultivars effect : S
LSD N = 0.164
LSD NxG = NS
LSD SxG = NS
LSD SxNxG = NS

Sowing date : NS
Cultivars effect : S
LSD N = 1.531
LSD NxG = NS
LSD SxG = 0.331
LSD SxNxG = 0.306

Table (7): Mean number of kernels spike^{-1} as influenced by sowing date, nitrogen levels, cultivars and their interactions in both seasons.

Sowing date	Cultivars	2012/2013					2013/2014				
		N levels (kg N fed^{-1})				Mean SxG	N levels (kg N fed^{-1})				Mean SxG
		0	30	60	90		0	30	60	90	
20/11	G130	29.3	33.7	36.0	38.7	34.4	22.7	26.0	28.3	34.0	22.8
	G135	31.3	37.7	42.0	44.3	38.8	18.0	20.7	22.7	25.3	26.1
20/12	G130	23.0	26.0	29.7	33.7	28.1	19.7	22.3	25.3	27.0	27.8
	G135	25.7	30.0	33.3	38.3	31.8	22.7	24.7	27.0	30.3	21.7
Mean NxG	G130	26.2	29.8	32.8	36.2		21.2	24.2	26.8	30.5	
	G135	28.5	33.8	37.7	41.3		20.3	22.7	24.8	27.8	
	Mean N	27.4	31.8	35.3	38.8		20.8	23.5	25.8	29.2	

Sowing date : S
Cultivars effect : S
LSD N = 1.110
LSD NxG = 1.570
LSD SxG = NS
LSD SxNxG = NS

Sowing date : NS
Cultivars effect : NS
LSD N = 0.899
LSD NxG = NS
LSD SxG = 1.369
LSD SxNxG = 1.798

cultivars significantly differed in the number of kernels spike^{-1} in both seasons. Giza 135 gave the highest kernels spike^{-1} in the 1st season while, Giza 130 produced the highest value in the 2nd season. The average of number of kernels spike^{-1} was 27.4, 31.8, 35.3 and 38.8 in the 1st season and 20.8, 23.5, 25.8 and 29.2 cm in the 2nd season with 0, 30, 60 and 90 kg N fed^{-1}, respectively. The effect of N fertilizer levels on kernels spike^{-1} was significant in both seasons. Application of nitrogen at the rate of 90kg N

fed^{-1} gave the highest number of kernels spike^{-1} (38.8 and 29.2 g) in the 1st and the 2nd seasons, respectively. These findings are in agreement with those obtained by Turk *et al.* (2003).

3.2.2. Spike kernel weight

Means of spike kernel weight are presented in Table (8). Results indicated that sowing date, cultivars, N levels and their interactions except GxN in the 1st season and SxN in the 2nd season had a significant ($p<0.05$) effect on the spike kernel weight. Sowing date on the 20th of Nov. produced heavier spike kernels weight than late sowing one. It varied from 0.91 to 1.80g in the 1st season and from 0.62 to 1.33 g in the 2nd season for early and late sowing date, respectively. Giza 130 gave the heaviest spike kernel weight as compared with Giza 135 in both seasons, respectively. The average of number of kernels spike^{-1} was 0.98, 1.11, 1.23 and 1.50 in the 1st season and 0.79, 0.86, 0.89 and 1.08 g in the 2nd season with 0, 30, 60 and 90 kg N fed^{-1}, respectively. Also the results showed that spike kernel weight was significantly increased by increasing nitrogen fertilizer levels in both seasons. Application of nitrogen fertilizer at the rate of 90kg N fed^{-1} gave the heaviest spike kernel weight (1.50 and 1.08g) in the 1st and the 2nd seasons, respectively. These results are in agreement with those of Said *et al*. (2012) and Mohamed (2009).

3.2.3.1000-Kernel weight

Analysis of data indicated that sowing dates, cultivars, N levels and their interactions except SxN and GxN in the 1st season and S in the 2nd were significant ($p<0.05$) Table (9). Sowing date on 20th Nov. produced heavier grains than late sown one in both seasons. It varied from 27.2 to 44.7g in the 1st season and from 23.3 to 35.9 g in the 2nd season respectively. These results are in agreement with those of Refay (2011) and Said *et al*. (2012). Giza 130 gave the heaviest 1000-kernal weight as compared with Giza 135 in both seasons, respectively. The average of number of kernels spike^{-1} was 30.6, 34.3, 37.5 and 40.1 g in the 1st season and 25.1, 27.6, 29.6 and 32.4 g in the 2nd season with 0, 30, 60 and 90 kg N fed^{-1}, respectively. Also, the results showed that 1000-kernal weight significantly increased with nitrogen fertilizer levels in both seasons, and application nitrogen fertilizer at the rate of 90kg N fed^{-1} gave the heaviest 1000-kernel weight (40.1 and 32.4 g) in the 1st and the 2nd seasons, respectively. These results are supported with those obtained by Abdur *et al*. (2010) and Refay (2011).

3.2.4. Biological yield

Results presented in Table (10) revealed high significant differences among sowing date, cultivars, N levels and their interaction in both seasons except SxG interaction in the 2nd season. It varied from 2.20 to 6.93 t fed^{-1} in the 1st season and from 2.47 to 6.97 t fed^{-1} in the 2nd season respectively. On the other hand, all interactions showed significant effect in both seasons. Maximum biological yield was recorded under the early sowing, while minimum biological yield was obtained from late sowing date in the 1st and the 2nd season respectively. The average of Biological yield was 3.00, 3.99, 4.85 and 6.28 t fed^{-1} in the 1st season and 2.94, 4.07, 4.77 and 6.13 t fed^{-1} in the 2nd season with 0, 30, 60 and 90 kg N fed^{-1}, respectively. Giza 130 gave the highest biological yield as compared with Giza 135 in both seasons, respectively. The results also showed that biological yield was significantly increased as nitrogen fertilizer levels increased in both seasons. The rate of 90 kg N fed^{-1} gave the highest biological yield (6.28 and 6.13 t fed^{-1}) in 1st and 2nd seasons, respectively. These finding are in harmony with those reported by El-Sayed *et al* (1991), El-Sayed *et al* (2000) and Mohamed (2009).

3.2.5. Grain yield

Table (11) and Figs (1 and 2) showed that sowing date, cultivars and N levels had a significant effect on grain yield in both seasons, It varied from 6.13 to 19.61 ard fed^{-1} in the 1st season and from 5.60 to 17.86 ard fed^{-1} in the 2nd season respectively. On the other hand, all interactions showed significant effect in both seasons. Maximum

Table (8): Mean spike kernels weight gm as influenced by sowing date, nitrogen level, cultivars and their interactions in both seasons.

Sowing date	Cultivars	2012/2013					2013/2014				
		N levels (kg N fed^{-1})				Mean SxG	N levels (kg N fed^{-1})				Mean SxG
		0	30	60	90		0	30	60	90	
20/11	G130	0.94	1.01	1.09	1.37	1.10	0.94	0.96	1.03	1.33	1.07
	G135	1.09	1.43	1.60	1.80	1.48	0.62	0.65	0.67	0.73	0.67
20/12	G130	0.91	0.98	1.17	1.47	1.13	0.70	0.83	0.88	0.93	0.84
	G135	0.96	1.01	1.06	1.33	1.09	0.92	0.96	0.98	1.30	1.04
Mean NxG	G130	0.93	0.99	1.12	1.42		0.81	0.90	0.95	1.13	
	G135	1.03	1.22	1.33	1.57		0.77	0.81	0.83	1.02	
	Mean N	0.98	1.11	1.23	1.50		0.79	0.86	0.89	1.08	

Sowing date : S
Cultivars effect : S
LSD N = 0.070
LSD NxG = NS
LSD SxG = 0.232
LSD SxNxG = 0.136

Sowing date : S
Cultivars effect : S
LSD N = 0.038
LSD NxG = NS
LSD SxG = 0.036
LSD SxNxG = 0.075

Table (9): Mean weight of 1000-kernel as influenced by sowing date, nitrogen level, cultivars and their interactions in both seasons.

Sowing date	Cultivars	2012/2013					2013/2014				
		N levels (kg N fed^{-1})				Mean SxG	N levels (kg N fed^{-1})				Mean SxG
		0	30	60	90		0	30	60	90	
20/11	G130	30.7	34.0	37.1	38.6	35.1	27.0	32.0	34.0	35.9	32.2
	G135	34.3	38.7	42.6	44.7	40.1	23.3	24.3	25.7	27.3	25.2
20/12	G130	27.2	30.3	35.0	38.7	32.8	25.0	27.3	30.0	33.7	29.0
	G135	29.8	33.8	35.2	38.2	34.3	25.0	26.7	28.7	32.7	28.3
Mean NxG	G130	29.0	32.2	36.1	38.6		26.0	29.7	32.0	34.8	
	G135	32.1	36.3	38.9	41.5		24.2	25.5	27.2	30.0	
	Mean N	30.6	34.3	37.5	40.1		25.1	27.6	29.6	32.4	

Sowing date : S
Cultivars effect : S
LSD N = 0.741
LSD NxG = NS
LSD SxG = 1.180
LSD SxNxG = 1.482

Sowing date : NS
Cultivars effect : S
LSD N = 0.584
LSD NxG = 0.826
LSD SxG = 2.561
LSD SxNxG = 1.169

Table (10): Mean biological yield ton fed^{-1} as influenced by sowing date, nitrogen level, cultivars and their interactions in both seasons.

Sowing date	Cultivars	2012/2013					2013/2014				
		N levels (kg N fed^{-1})				Mean SxG	N levels (kg N fed^{-1})				Mean SxG
		0	30	60	90		0	30	60	90	
20/11	G130	3.67	4.17	5.57	6.93	5.04	3.73	4.22	5.87	6.83	5.16
	G135	2.40	4.27	4.80	6.77	4.56	3.00	4.30	4.83	6.97	4.78
20/12	G130	3.73	4.23	5.17	6.63	4.94	2.53	3.96	4.27	5.73	4.12
	G135	2.20	3.30	3.63	4.80	3.49	2.47	3.80	4.10	5.20	3.89
Mean NxG	G130	3.70	4.20	5.37	6.78		3.13	4.09	5.07	6.17	
	G135	2.30	3.78	4.33	5.78		2.73	4.05	4.46	6.08	
	Mean N	3.00	3.99	4.85	6.28		2.94	4.07	4.77	6.13	

Sowing date : S
Cultivars effect : S
LSD N = 0.561
LSD NxG = 0.793
LSD SxG = 0.699
LSD SxNxG = 1.122

Sowing date : S
Cultivars effect : S
LSD N = 0.406
LSD NxG = 0.573
LSD SxG = NS
LSD SxNxG = 0.811

Table (11): Mean gran yield (ard fed^{-1}) as influenced by sowing date, nitrogen level, cultivars and their interactions in both seasons.

Sowing date	Cultivars	2012/2013					2013/2014				
		N levels (kg N fed^{-1})				Mean SxG	N levels (kg N fed^{-1})				Mean SxG
		0	30	60	90		0	30	60	90	
20/11	G130	8.47	10.57	17.09	19.61	13.94	10.96	11.94	17.16	17.86	14.50
	G135	6.13	11.94	13.76	16.11	11.97	8.33	13.10	12.92	15.02	12.36
20/12	G130	6.41	8.05	10.85	13.62	9.73	5.85	8.02	10.57	14.67	9.77
	G135	6.93	7.39	8.75	12.08	8.79	5.60	7.07	8.61	10.43	7.95
Mean NxG	G130	7.46	9.31	13.97	16.63		8.40	9.98	13.83	16.28	
	G135	6.55	9.66	11.27	14.11		6.97	8.33	10.78	12.71	
	Mean N	7.00	9.49	12.61	15.37		7.70	9.17	12.32	14.50	

Sowing date : S
Cultivars effect : S
LSD N = 0.195
LSD NxG = 0.276
LSD SxG = 0.443
LSD SxNxG = 0.391

Sowing date : S
Cultivars effect : S
LSD N = 0.125
LSD NxG = 0.177
LSD SxG = 0.124
LSD SxNxG = 0.250

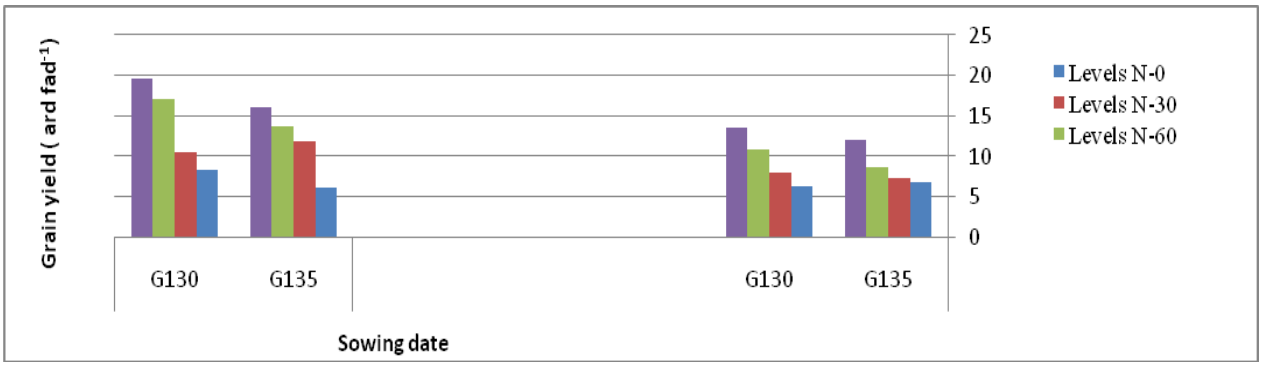

Fig. (1): Mean of grain yield (ard fed^{-1}) as influenced by sowing date, nitrogen levels and cultivars in 2012/2013.

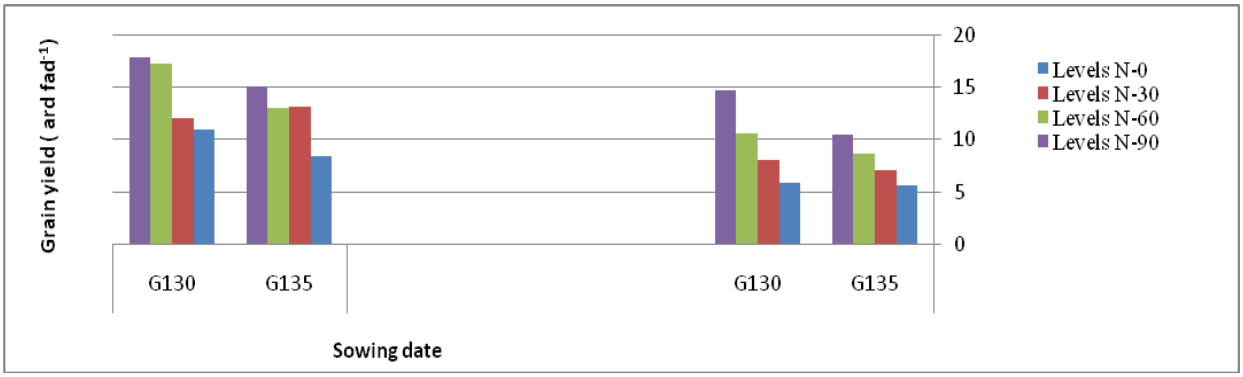

Fig. (2): Mean of grain yield (ard fed^{-1}) as influenced by sowing date, nitrogen levels and cultivars in 2013/2014.

grain yield was recorded from the 20th of Nov planting date, while minimum grain yield was obtained from the 20th of Dec. in both seasons respectively. These results are in agreement with those of Yesmin *et al*. (2014).Giza 130 gave the highest grain yield as compared with Giza 135 in both seasons, respectively. The average of grain yield was 7.00, 9.49, 12.61 and 15.37 ard fed^{-1} in the 1st season and 7.70, 9.17, 12.32 and 14.50 ard fed^{-1} in the 2nd season with 0, 30, 60 and 90 kg N fed^{-1}, respectively. Increasing nitrogen fertilizer had a significant effect on grain yield in both seasons, and application of nitrogen fertilizer at the rate of 90 kg fed^{-1} gave the highest grain yield (15.37 and 14.50 ard fed^{-1}) in the 1st and the 2nd seasons, respectively. This observation agreed with that recorded by Refay (2011) and Said *et al*. (2012).

3.2.6. Straw yield (SY)

Results presented in Table (12) revealed significant differences among sowing date, cultivars and N levels in both seasons, except for cultivars in the 2nd season insignificant effect on straw yield. It varied from 1.37 to 5.00 t fed^{-1} in the 1st season and from 1.79 to 5.17 t fed^{-1} in the 2nd season respectively. On the other hand, all interactions showed significant effect with the exception of SxG in both seasons. Maximum SY was recorded from 20th Nov. sowing date in the 1st and the 2nd seasons, respectively, while minimum SY was obtained from 20th Dec. in the 1st and the 2nd seasons, respectively. Giza 130 gave the

Table (12): Mean straw yield (ton fed^{-1}) as influenced by sowing date, nitrogen level, cultivars and their interactions in both seasons.

Sowing date	Cultivars	2012/2013					2013/2014				
		N levels (kg N fed^{-1})				Mean SxG	N levels (kg N fed^{-1})				Mean SxG
		0	30	60	90		0	30	60	90	
20/11	G130	2.65	2.90	3.52	4.58	3.41	2.42	2.78	3.81	4.69	3.43
	G135	1.66	2.84	3.15	4.83	3.12	2.00	2.73	3.28	5.17	3.30
20/12	G130	2.97	3.27	3.86	5.00	3.78	1.83	3.00	3.00	2.71	2.64
	G135	1.37	2.42	2.58	3.35	2.43	1.79	2.95	3.07	3.95	2.94
Mean NxG	G130	2.81	3.08	3.69	4.79		2.13	2.89	3.41	4.22	
	G135	1.52	2.63	2.97	4.10		1.90	3.05	3.17	4.56	
	Mean N	2.16	2.86	3.33	4.23		2.01	2.97	3.29	4.39	

Sowing date : S
Cultivars effect : S
LSD N = 0.564
LSD NxG = 0.798
LSD SxG = NS
LSD SxNxG = 1.128

Sowing date : NS
Cultivars effect : NS
LSD N = 0.363
LSD NxG = 0.514
LSD SxG = NS
LSD SxNxG = 0.726

highest SY as compared with Giza 135 in 1st season. The average of Straw yield was 2.16, 2.86, 3.33 and 4.23 t fed^{-1} in the 1st season and 2.01, 2.97, 3.29 and 4.39 t fed^{-1} in the 2nd season with 0, 30, 60 and 90 kg N fed^{-1}, respectively. Also the results showed that SY was significantly affected by nitrogen fertilizer levels in both seasons, and application of nitrogen fertilizer at the rate of 90 kg fed^{-1} gave the highest SY (4.23 and 4.39 t fed^{-1}) in the 1st and the 2nd seasons, respectively. These results are in harmony with those reported by El-Sayed *et al.* (1991), Mohamed (2009) and Said *et al*. (2012).

3.2.7. Harvest index (HI)

Harvest index (HI) of barley was significantly affected by sowing date in both seasons Table (13). Maximum HI % was recorded from 20th Nov. sowing date in both seasons, respectively, while minimum HI % was obtained from 20th Dec. in 2012/13 and 2013/14 seasons, respectively. It varied from 20.6 to 37.8% in the 1st season and from 22.3 to 36.5% in the 2nd season respectively. Results showed that there was a significant difference between the two barley cultivars for HI in both seasons. Giza 130 gave HI of as compared with Giza 135 in the 1st and the 2nd seasons, respectively. The average of harvest index was 29.3, 28.4, 31.4 and 29.4% in the 1st season and 31.4, 27.0, 30.9 and 28.4% in the 2nd season with 0, 30, 60 and 90 kg N fed^{-1}, respectively. Giza 130 gave the highest HI as compared with Giza 135 in the 1st and the 2nd seasons, respectively. Also the results showed that HI was significantly increased with increasing nitrogen fertilizer level in both seasons, and application of nitrogen fertilizer at the rate of 60 kg N fed^{-1} gave the highest HI (31.4 and 30.9%) in the 1st and the 2nd seasons, respectively. These results are in agreement with those obtained by Alam *et al*. (2007), Mohamed (2009) and Said *et al*. (2012).

Conclusion

From the previous results, it could be concluded that barley Giza 130 is performing well, when it is planted at 20th Nov with N fertilizer level of 90 kg N fed^{-1} to achieve the highest grain yield under the New Valley conditions.

Table (13): Mean harvest index as influenced by sowing date, nitrogen level, cultivars and their interaction in both seasons.

Sowing date	Cultivars	2012/2013					2013/2014				
		N levels (kg N fed^{-1})				Mean SxG	N levels (kg N fed^{-1})				Mean SxG
		0	30	60	90		0	30	60	90	
20/11	G130	27.7	30.4	36.8	33.9	33.2	35.2	34.0	35.1	31.4	33.9
	G135	30.7	33.6	34.4	28.6	31.8	33.3	36.5	32.0	25.9	31.9
20/12	G130	20.6	22.8	25.2	24.6	23.3	27.7	24.3	29.7	30.7	28.9
	G135	37.8	26.8	28.9	30.2	30.9	27.3	22.3	25.2	24.1	24.7
Mean NxG	G130	24.2	26.6	31.2	29.3		32.2	29.3	32.8	31.7	
	G135	34.3	30.2	31.7	29.4		30.6	24.7	29.0	25.1	
	Mean N	29.3	28.4	31.4	29.4		31.4	27.0	30.9	28.4	

Sowing date : S
Cultivars effect : S
LSD N = 2.20
LSD NxG = 3.8
LSD SxG = NS
LSD SxNxG = 5.3

Sowing date : S
Cultivars effect : S
LSD N = 1.2
LSD NxG = 1.7
LSD SxG = NS
LSD SxNxG = 2.4

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