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Response of some Barley Cultivars to Late Sowing Dates and Nitrogen Fertilizer Rates Under the New Valley Condition

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Abstract

This investigation was carried out at El-Dakhla Oasis in the New Valley Governorate, Egypt, during the two growing seasons of 2013/2014 and 2014/2015 to study the response of some barley cultivars to late sowing date and nitrogen fertilizer rates under the New Valley condition. Three experiments were conducted separately for each sowing date (1st Dec., 20th Dec. and 10th Jan. i.e. S_1, S_2 and S_3) in both seasons. The randomized complete block design using split plot with three replications was employed, where the nitrogen fertilizer rates (50, 70 and 90 kg N/fed. i.e. N_1, N_2 and N_3) were assigned in the main plots, while the cultivars (Giza 123, Giza 129 and Giza 130 i.e. Cv. 1, Cv. 2 and Cv. 3) were allocated in the sub-plots. The plot area was 10.5 m^2 including 3x3.5 m (1/400 fed).

The results could be summarized as the following:

- Sowing date at 1st Dec. recorded the highest mean values for the plant height and spike length in the 1st season, and 1000 grain weight in the both seasons. Moreover, the tallest plants and the greatest number of spikes/m^2 in the 2nd season and the maximum grain yield/fed. in the both seasons were recorded by sowing date at 20th Dec.

- Number of spikes/m^2, 1000 grain weight and grain yield/fed. increased with increasing N fertilizer rates up to 70 kg N/fed., as well as the tallest plants was obtained by 90 kg N/fed. rate in the both seasons.

- Giza 123 cultivar surpassed the Giza 129 and Giza 130 cultivars and gained the highest mean values for 1000 grain weight and grain yield/fed. in the both seasons and number of spikes/m^2 and plant height in the 1st and 2nd seasons, respectively, while Giza 129 cultivar gave the tallest plants and the greatest number of spikes/m^2 in the 1st and 2nd seasons, respectively.

- The S_3xN_1 (10th Jan. x 50 kg N/fed.) interaction treatments gave the minimum values for the plant height in the both seasons and number of spikes/m^2 in the 1st season, as well as S_3xN_3 (10th Jan. x 90 kg N/fed.) interaction treatments gave the minimum values for 1000 grain weight and grain yield/fed. in the both seasons. However, the maximum mean values for 1000 grain weight and grain yield/fed. were obtained by S_2xCv.1 (20th Dec. x Giza 123 cultivar) interaction treatment and N_2xCv.1 (70 kg N/fed. x Giza 123 cultivar) interaction treatments in the both seasons.

- The highest mean values for 1000 grain weight and grain yield/fed. in the both seasons and number of spikes/m^2 in the 2nd season were achieved by S_2xN_3xCv.1 (20th Dec. x 90 kg N/fed. x Giza 123 cultivar) interaction treatments.

Keywords: *Barley cultivars, N fertilizer rates, Sowing dates and Interaction treatments.*

Introduction

Barley (*Hordeum sativum*, Jess) is the world's fourth most important cereal crop and the fourth ranking cereal in Egypt after wheat, maize and rice. Barley is grown over a border that is produced in regions with climates unfavorable for production of other major cereals. It is said that barley is the most widely cereals and it is more tolerant to drought and nutrient deficiencies than other cereals.

Sowing date is one of the major factors which determines the ability of the crop to stand against different environmental conditions (air temperature and humidity). Juskiw and Helm (2003) found that early sowing on barley resulted in grain yield advantages of 113 to 134%, while with late sowing grain yield was reduced 54 to 76% of the mean site yield. Late sowing date reduced the period from sowing to emergence, vegetative period, grain filling period, time from emergence to physiological maturity, test weight, grain yield and number of tillers per plant, however it increased plant height. Kavak (2004) reported that late sowing date caused in a decrease in total grain yield and yield components of barley. He added that late sowing date resulted in grain yield reduction of 10.1 and 6% for the first and second sowing dates in 2000, respectively, when compared with the control plots. Tammam and Tawfelis (2004) observed that normal sowing date gave higher grain yield than late sowing. They added that early sowing date produced the highest number of spikes/m^2, 1000-grain weight and grain yield. Hassan and Moftha, Amal (2012) stated that the effect of sowing dates were significant on plant height, number of spikes/m^2, seed index and grain yield. Said *et al*. (2012) mentioned that appropriate sowing date is important to have the crop in the field, when environmental conditions are conducive for growth and development. Alghabari and Al-Solaimani (2015) stated that delay in planting time such as December 05 reduced the number of spikes/m^2, 1000-grain weight and grain yield/fed. Mirosavljević *et al*. (2015) reported that the highest grain yield was obtained with early sowing date. Delayed sowing dates resulted in reduced grain yield, a shorter overall growth cycle and increased temperature during grain filling.

Fertilizers is rich source of plant nutrient required for increased crop productivity. It is essential to know the best level of fertilizer application for getting a higher crop yield, so that maximum benefits could be achieved. Nitrogen is one of the major macronutrients that is the most important treatment to increase grain and straw yields in barley cultivars. Salem *et al*. (2000) stated that the highest values of plant height, number of spikes/m^2 and grain yield could be recorded by 107 kg N/had. Ahmed *et al*. (2001) showed that the highest level of nitrogen fertilizer produced the highest values of plant height and grain yield. They added that four cultivars exceeded significantly the national check Giza 123 in grain yield under the low level of nitrogen fertilization. Megahed (2003) reported that increasing nitrogen fertilizer rate from 71.4 or 142.8 to 214.2 kg N/ha caused significant increases of plant height, spike length, number of spikes/m^2, 1000 grain weight and

grain yield of barley. Zeidan (2007) revealed that increasing N-rates from 30 to 70 kg N/fed. resulted in an increase in plant height, number of spikes/m^2, 1000-grain weight and grain yield/fed. Mousavi *et al*. (2012) declared that with increasing in nitrogen fertilizer the number of spikes/m^2 was increased and led to increase production of grain yield on barley. Aghdam and Samadiyan (2014) confirmed that nitrogen fertilizer of 150 kg/ha gave the maximum number of spikes/^{2}, plant height and spike length. Alghabari and Al-Soliamani (2015) found that the highest level of nitrogen fertilizer (200 kg/ha) leads to an increase in plant height, number of spikes/m^2, spike length and 1000 grain weight. Gezahegen and Kefale (2016) concluded that the maximum grain yield (4918.3 kg/ha) was obtained from Bahat variety with the highest level 98.5 kg N/ha fertilizer application.

Different new varieties were realized. These varieties need some information about agricultural practices to reach the potentiality of each variety. Afify (1999) reported that there were significant differences among barley cultivars in plant height, spike length, 1000 grain weight and grain yield. Badawi (2004) indicated that cultivars No. 14 and 11 had the highest grain yield, while the cultivar No. 15, 16 and 18 had the highest 1000 grain weight. Zeidan (2007) mentioned that Giza 123 surpassed the Giza 124, Giza 126 and Giza 130 cultivrs in plant height, number of spikes/m^2, 1000 grain weight and grain yield/ha. Aghdam and Samadiyan (2014) concluded that the Nura barley cultivar had the highest mean values for plant height, spike length, number of spikes/m^2 and grain yield/ha. Mirosaljevit *et al*. (2015) mentioned that the highest grain yield was recorded with the late and medium early barley genotypes. Thus, the appropriate sowing date, suitable cultivar and proper nutrition are very important to get higher yield. Hence, the present study was carried out to find out the response of some barley cultivars to delayed sowing date and nitrogen fertilizer rates under the New Valley condition.

Materials and Methods

The present investigation was carried out at El-Dakhla Oasis in the New Valley Governorate during the two winter growing seasons of 2013/2014 and 2014/2015 to study the response of some barley cultivars to late sowing dates and nitrogen fertilizer rates under the New Valley condition. The used soil of these experiments was sandy clay loam and its structure as presented in Table 1.

Table 1. Some of physical and chemical properties of a representative soil sample from the experimental site in both seasons.

Season	Physical				Chemical						
	Sand (%)	Silt (%)	Clay (%)	Texture	$CaCO_3$ (%)	Oc (%)	ECe (dS/m)	pH 1:1	Total N (%) (mg/kg)	Olsen-P (mg/kg)	CH_3COONH_4-K (mg/kg)
2013/ 2014	67	8	24	Sandy clay loam	4.53	0.58	5.75	7.9	761.60	6.10	374.10
2014/ 2015	66.5	10	23.5	Sandy clay loam	4.50	0.56	5.80	7.8	760.00	6.05	375.0

As well as, the assist in discussing the results, data of daily minimum (Min.) and maximum (Max.) temperature along with relative humidity during the two growing seasons at El-Dakhla Oasis in the New Valley are shown in Table 2.

Table 2. Average of monthly temperature and relative humidity at the experimental farm during the two growing seasons*.

Season / Month	Day	2013/2014			2014/2015		
		Temperature		Relative humidity %	Temperature		Relative humidity %
		Max.	Min.		Max	Min.	
December	1-10	22.5	14.8	38.4	28	12.0	48.2
	11-20	19.5	6.4	51.3	22.8	12.6	50.9
	21-31	23.9	8.7	46	25	8.9	56
	Average	21.9	9.9	45.2	25.3	11.2	51.7
January	1-10	25	6.6	51	17.8	5	48.9
	11-20	24.9	8.3	50	21.8	5.3	55.7
	21-31	34.3	7.9	35.5	29.8	9.5	31
	Average	28	7.6	45.5	23.1	6.6	44.9
February	1-10	24.5	8.7	42.5	28.2	8	39.8
	11-20	25.9	10.6	41.3	21.6	8.4	48.6
	21-29	26.7	10	42	25.9	8.6	42.5
	Average	25.7	9.8	41.9	25.2	8.4	43.6
March	1-10	30.5	15.8	34.7	28.9	14	37
	11-20	27.5	11.5	36	29.5	12	37.9
	21-31	32	14.1	28	36.3	17.9	30.7
	Average	30	13.8	32.9	31.6	14.6	35.2
April	1-10	32.3	15.8	28.3	31.7	15.3	32.4
	11-20	36	18.3	23.7	28.4	13.4	26.8
	21-30	38.6	20.6	23.7	35.8	17.8	22.7
	Average	35.5	18.2	25.2	31.9	15.5	27.3

* Source: El-Dakhla meteorological station.

Experimental Design:

Three experiments were conducted separately for each sowing date (the first experiment with 1st December (Dec.) the second experiment with 20th Dec. and the third experiment with 10th January (Jan.). The nitrogen fertilizer rates and barley cultivars were assigned under three sowing dates in the two seasons. The field experiment was carried out in a randomized complete block design (RCBD) using a split plot arrangement with three replications. The nitrogen fertilizer rates (50, 70 and 90 kg N/fed.) were assigned in the main plot and the barley cultivars (Giza 123, Giza 129 and Giza 130) were allotted in the sub-plot.

The barley grains were sown by hand broadcasting at a seeding rate of 50 kg/fed. The plot area was 10.5 m^2 (3x3.5 m) and nitrogen fertilizer in the form of ammonium nitrate (33.5 N) was used. Recommend rate of super phosphate 15.5% P_2O_5 (150 kg/fed.) was broadcasted before sowing. Barley cultivars were sown in an experimental area without proceeding crops cultivation in the both season. Other agricultural practices were performed as recommended for barley production.

Characters, sampling and measurement:

At harvest, a sample of five guarded plants was taken randomly from each sub-plots in three replicates to determine the following characters: Plant height (cm): measured from soil surface to the tip of the spike excluding awns; Spike length (cm): measured from the base of the spike to its tip excluding awns; Number of spikes/m^2: sample of one square meter was randomly taken from each sub-plot; 1000-grain weight (g): it was recorded from a grain sample take at random from each sub-plot and grain yield/fed: it estimated from the harvested plot area after over drying and weighing, grains were threshed from the straw, cleaned and weighed in kilograms and converted into ardab/feddan.

Statistical analysis:

All the obtained data for each season that it combined over the three sowing dates were exposed to proper statistical analysis of variance according to Gomez and Gomez (1984) using the MSTAT-C Statistical Software Package described by Co-Stat (2004). The least significant difference (LSD) at 5% level of probability were computed to detect the difference among means.

Results and Discussion

Main effects:

Data in Table 3 revealed that the most studied traits i.e. plant height, number of spikes/m^2, 1000 grain weight and grain yield/fed. had a highly significantly affected by sowing dates in the both seasons, except number of spikes/m^2 in the 1st season and grain yield/fed. in the 2nd season did not significantly affected by this trail. The highest mean values for the plant height (124.3 cm) and spike length (8.19 cm) in the 1st season and 1000 grain weight (66.29 and 67.07 g) in the both seasons were obtained by sowing date at 1st Dec., moreover, the highest ones for the plant height (128.2 cm) in the 2nd season and grain yield/fed. (13.27 and 16.28 ard.) in the both season were obtained by sowing date at 20th Dec. The results mean that the 1st and 2nd sowing dates were the effective for achieving the maximum mean values for the most studied traits. The differences among the sowing dates could be attributed to the environmental conditions (temperature and relative humidity) are conducive for growth and development. Hassan and Moftha, Amal (2012) recommended that sowing date of mid December gave the highest grain yield/ha as compared to other sowing dates. These results are in confirmity with those reported by Juskiw and Helm (2003), Kavak (2004), Tammam and Tawfelis (2004), Abdel-Nour, Nadia and Fateh, Hayam (2011), Kavitha *et al*. (2012) and Alghabari and Al-Solaimani (2015).

Regarding to nitrogen fertilizer rates, the results in the same Table showed that the plant height, 1000 grain weight and grain yield/fed. had a highly significantly affected by nitrogen fertilizer rates in the both season, as well as spike length in the 1st season exerted significantly influence by the nitrogen fertilizer rates, whilst number of spikes/m^2 did not significantly affected by this trail in the both seasons. In general, the above studied traits increased by increasing N fertilizer rates and the maximum mean

values were realized by either 70 kg N/fed. or 90 kg N/fed. in the both seasons. It is clear from these data that N fertilizer to barley enhanced the vegetative growth of the plant, increased photosynthetic activity and metabolites required to produce long spikes, increase 1000 grain weight and consequently reacted barley yield. Alghahari and Al-Solaimani (2015) stated that the highest nitrogen fertilizer level (200 kg/ha) led to an increase in plant height, spike length, number of spikes/m^2 and 1000 grain weight. These results are coincided with those mentioned by Salem *et al*. (2000), Megahed (2003), Gaballa *et al*. (2009), El-Metwally *et al*. (2010), Shafi *et al*. (2011), Mousavi *et al*. (2012) and Aghdam and Samadiyan (2014). However, Kavitha *et al*. (2012) mentioned that the highest nitrogen level significantly decreased 1000 grain weight.

Concerning with barley cultivars, the data in the same Table the cultivars had a highly significantly effect on the all studied traits in the both seasons, except plant height in the 1st season and spike length in the 2nd season did not significant by this trail. The Giza 123 cultivar gave the tallest plants (119.0 cm) in the 2nd season and the greatest number of spikes/m^2 (542.1) in the 1st season, the heaviest 1000 grain (70.00 and 69.90 g) and the maximum grain yield/fed. (13.63 and 15.44 ard.) in the both season, as well as the Giza 129 cultivar gave the greatest number of spikes/m^2 (465.1) in the 2nd season and the tallest plants (119.5 cm) in the 1st season, moreover the Giza 130 cultivar gave the longest spikes (8.33 and 7.27 cm) in the both seasons. The results mean that the Giza 123 cultivar was the effective for realizing the maximum values for the all studied traits except spike length. The differences among the barley cultivars could be attributed to the genetic make up. Affify (1999) reported that significant differences among barley cultivars in plant height, spike length, 1000 grain weight and grain yield. These results are in agreement with those stated by El-Kholy and El-Bawab (1998), Badawi (2004), Zeidan (2007) and Alghabari and Al-Solaimani (2015).

Table 3. Main effect of sowing dates (S), nitrogen fertilizers (N) and barley cultivars (Cv.) on the plant height, yield components and yield for barley in the first and second seasons.

Characters / Main effects	Plant height (cm)		Spike length (cm)		Number of spikes/m^2		1000 grain Weight (g)		Grain yield/fed. (ard.)	
	2013/14	2014/15	2013/14	2014/15	2013/14	2014/15	2013/14	2014/15	2013/14	2014/15
Sowing dates (S)										
S_1	124.3	112.8	8.19	6.68	458.2	436.7	66.29	67.07	11.73	12.74
S_2	121.1	128.2	7.94	7.23	508.0	472.0	65.39	65.44	13.27	16.28
S_3	112.4	95.3	7.67	7.63	557.6	400.9	60.41	60.69	10.83	11.89
F- test	**	**	N.S.	N.S.	**	N.S.	**	**	N.S.	**
LSD 5 %	1.6	3.1	-	-	11.9	-	2.30	2.20	-	1.32
Nitrogen fertilizer(N)										
N_1	115.6	109.5	7.76	7.27	501.0	426.7	64.58	64.52	11.70	13.87
N_2	120.9	11.0	7.82	7.23	521.7	442.1	65.06	65.15	12.57	14.18
N_3	121.5	115.8	8.22	7.03	501.2	440.7	62.50	63.48	11.55	12.86
F – test	**	**	**	N.S.	N.S.	N.S.	**	*	**	*
LSD 5 %	2.3	3.0	0.28	-	-	-	1.59	1.11	0.72	0.93
Cultivars (Cv.)										
Cv.1	118.9	119.0	7.52	7.07	542.1	447.3	70.00	69.90	13.63	15.44
Cv.2	119.5	107.3	8.33	7.20	513.4	456.1	59.23	60.74	10.47	13.42
Cv.3	119.4	110.0	7.94	7.27	468.4	406.2	62.86	62.55	11.73	12.04
F – test	N.S.	**	**	N.S.	**	**	**	**	**	**
LSD 5 %	-	3.5	0.22	-	25.1	16.3	0.76	1.37	0.93	0.56

S_1= 1st Dec., S_2= 20th Dec., S_3= 10th Jan., N_1= 50 kg N/fed., N_2= 70 kg N/fed., N_3= 90 kg N/fed., Cv.1= Giza 123, Cv.2= Giza 129 and
Cv.3= Giza 130
*, ** indicated to significantly and highly significantly at 5% and 1% levels of probability, respectively.
N.S. = Non-significant differences. LSD= Least Significant Difference.

Interaction effect:

Data in Table 4 pointed out that the sowing dates x nitrogen fertilizer (SxN) interaction had a significantly effect on the plant height and 1000 grain weight in the both seasons, spike length and number of spikes/m^2 in the 2nd season and grain yield in the 1st season. The tallest plants (125.3 and 131.1 cm) were stated by S_1xN_1 (1st Dec. x 50 kg N/fed.) and S_2xN_3 (20th Dec. x 90 kg N/fed.), as well as the heaviest 1000 grain (66.58 and 69.11 g) were realized by S_2xN_1 (20th Dec. x 50 kg N/fed.) and S_1xN_3 (1st Dec. x 90 kg N/fed.) in the 1st and 2nd seasons, respectively. Moreover, the greatest number of spikes/m^2 (504.2) followed by (467.7) were obtained by S_2xN_2 (20th Dec. x 70 kg N/fed.) followed by S_2xN_3 (20th Dec. x 90 kg N/fed.) in the 2nd season, as well as the maximum grain yield/fed. (13.98 ard.) followed by (13.51 ard.) were obtained by S_2xN_2 followed by S_2xN_3 without significant differences between them in the 1st season. Hence, the maximum grain yield/fed. may be correlated with the greatest number of spikes/m^2. On the other hand, the thinnest 1000 grain (56.45 and 56.34 g) and the minimum grain

yield/fed. (10.00 and 11.03 ard.) in the both season were obtained by S_3xN_3 (10^{th} Jan. x 90 kg N/fed.). Moreover, the shortest plants (101.7 and 88.3 cm) in the both seasons were obtained by S_3xN_1 (10^{th} Jan. x 50 kg N/fed.), as well as the lowest number of spikes/m^2 (390.6) in the 2^{nd} season was obtained by S_3xN_2 (10^{th} Jan. x 70 kg N/fed.). Here, the relation among the three nitrogen fertilizer rates under the three sowing dates was different in the both seasons. Rashid *et al*. (2010) reported that the interaction between sowing dates and nitrogen fertilizer levels gave the highest grain yield on barley. Similar findings were found by Kavitha *et al*. (2012) and Alghabari and Al-Solaimani (2015).

With respect to the interaction between sowing dates x Cultivars (SxCvs.), the data in Table 5 showed that the all studied traits excerted significantly influenced by the sowing dates x Cultivars in the both seasons, except spike length did not influence by this interaction in the 1^{st} season. The heaviest 1000 grain (74.20 and 74.22g), the maximum gain yield/fed. (15.72 and 17.72 ard.) in the both seasons and the tallest plants in the 2^{nd} season were recorded by $S_2xCv.1$ (20^{th} Dec. x Giza 123 cultivar). Moreover, the tallest plants (128.9 and 129.1 cm) were recorded by $S_1xCv.2$ and $S_2xCv.1$, as well as the greatest number of spikes/m^2 (613.3 and 501.3) were recorded by $S_3xCv.1$ and $S_2xCv.2$ in the 1^{st} and 2^{nd} seasons, respectively. The difference among the cultivars under three sowing dates could be attributed to the genetic make up. However, the shortest plants (109.3 and 86.7), the thinnest 1000 grain (53.67 and 57.44 g) in the both seasons and the minimum grain yield/fed. (9.54 ard.) in the 1^{st} season were obtained by $S_3xCv.2$ (10^{th} Jan. x Giza 129 cultivar). Moreover, the lowest number of spikes/m^2 (377.1) and the minimum grain yield/fed. (9.63 ard.) were obtained by $S_3xCv.3$ (10^{th} Jan. x Giza 130 cultivar) in the 2^{nd} season. These results are in conformity with those noted by Juskiw and Helm (2003), Leszczynska and Noworolnik (2005), Ram *et al.* and Soleymani *et al*. (2011).

Table 4. Interaction of sowing dates and nitrogen fertilizer (S x N) on the plant height, yield components and yield for barley in the first and second seasons.

Characters / Interaction (S x N)		Plant height (cm)		Spike length (cm)		Number of spikes/m^2		1000 grain weight (g)		Grain yield/fed. (ard.)	
		2013/14	2014/15	2013/14	2014/15	2013/14	2014/15	2013/14	2014/15	2013/14	2014/15
S_1	N_1	125.3	113.1	7.84	6.47	452.2	435.6	66.51	66.00	11.34	12.52
	N_2	123.7	110.1	8.20	6.84	463.8	431.7	66.12	66.10	12.70	13.02
	N_3	123.9	115.2	8.51	6.72	458.7	443.0	66.22	69.11	11.15	12.67
S_2	N_1	119.9	127.2	7.76	7.64	485.3	444.0	66.58	67.11	12.33	17.00
	N_2	118.3	126.2	7.84	7.15	528.3	504.2	64.94	64.22	13.98	16.98
	N_3	125.1	131.1	8.22	6.88	510.4	467.7	64.68	65.00	13.51	14.87
S_3	N_1	101.7	88.3	7.67	7.71	565.3	400.6	60.67	60.45	11.43	12.09
	N_2	120.7	96.6	7.41	7.70	573.1	390.6	64.11	65.11	11.04	12.53
	N_3	115.3	101.0	7.92	7.50	534.4	411.4	56.45	56.34	10.00	11.03
F - test		**	*	N.S.	*	N.S.	*	**	**	*	N.S.
LSD 5 %		3.9	5.2	-	0.42	-	34.6	2.76	1.93	1.24	-

S_1= 1st Dec., S_2= 20th Dec., S_3= 10th Jan., N_1= 50 kg N/fed., N_2= 70 kg N/fed. and N_3= 90 kg N/fed.
*, ** indicated to significantly and highly significantly at 5% and 1% levels of probability, respectively.
N.S. = Non-significant differences. LSD= Least Significant Difference.

Table 5. Interaction of sowing dates and cultivars (S x Cv.) on the plant height, yield components and yield for barley in the first and second seasons.

Characters / Interaction (S x Cv.)		Plant height (cm)		Spike length (cm)		Number of spikes/m^2		1000 grain weight (g)		Grain yield/fed. (ard.)	
		2013/14	2014/15	2013/14	2014/15	2013/14	2014/15	2013/14	2014/15	2013/14	2014/15
S_1	Cv.1	120.3	116.7	7.75	6.73	491.0	493.3	69.90	70.22	13.09	12.82
	Cv.2	128.9	108.3	8.62	6.47	475.0	425.9	63.09	63.56	11.61	13.54
	Cv.3	123.7	113.4	8.18	6.83	408.7	391.0	65.87	67.44	10.50	11.84
S_2	Cv.1	121.1	129.1	7.49	7.07	521.9	464.1	74.20	74.22	15.72	17.72
	Cv.2	120.4	126.8	8.55	7.31	534.4	501.3	60.94	61.22	10.25	16.48
	Cv.3	121.8	128.7	7.78	7.30	467.8	450.4	61.00	60.89	13.84	14.64
S_3	Cv.1	115.2	111.3	7.32	7.41	613.3	384.4	65.89	65.11	12.09	15.79
	Cv.2	109.3	86.7	7.82	7.81	530.9	441.0	53.67	57.41	9.54	10.23
	Cv.3	112.4	87.9	7.86	7.68	528.7	377.1	61.67	59.33	10.84	9.63
F - test		**	**	N.S.	*	*	**	**	**	**	*
LSD 5 %		3.6	6.1	-	0.29	43.5	28.2	1.32	2.37	1.61	0.97

S_1= 1st Dec., S_2= 20th Dec., S_3= 10th Jan., Cv.1= Giza 123, Cv.2= Giza 129 and Cv.3= Giza 130
*, ** indicated to significantly and highly significantly at 5% and 1% levels of probability, respectively.
N.S. = Non-significant differences. LSD= Least Significant Difference.

As for the interaction between nitrogen fertilizers with barley cultivars (NxCvs.), the results in the Table 6 declared the nitrogen fertilizers x Cultivars had a highly significantly effected on the plant height, number of spikes/m^2 and grain yield/fed. in the both seasons and 1000 grain weight in the 2nd season. However, the spike length did not show any significant affected by this interaction. The heaviest 1000-grain (71.10 and 71.22 g), the maximum grain yield/fed. (15.66 and 15.86) in the both seasons, as well as the greatest number of spikes/m^2 (592.7) in the 1st season and the tallest plants (123.3 cm) in the 2nd season were achieved by N_2xCv.1 (70 kg N/fed. x Giza 123 cultivar). Moreover, the tallest plants (123.3 cm) in the 1st season and the greatest number of spikes/m^2 (487.6) in the 2nd season were achieved by N_3xCv.2 (90 kg N/fed. x Giza 129 cultivar). The difference among the cultivars under different nitrogen quantities could be attributed to the genetic make up. On the contrary, the shortest plants (113.6 and 100.0 cm) were recorded by N_1xCv.3 (50 kg N/fed. x Giza 130 cultivar) and N_1xCv.2 (50 kg N/fed. x Giza 129 cultivar) in the 1st and 2nd seasons, respectively. Moreover, the minimum mean values for number of spikes/m^2 (465.3), 1000 grain weight (60.11 g) and grain yield/fed. (9.90 ard.) in the 2nd season were recorded by N_3xCv.2 (90 kg N/fed. x Giza 129 cultivar), as well as the thinnest 1000 grain (58.88 g) and the minimum grain yield/fed. (9.90 ard.) were recorded by N_3xCv.2 (90 kg N/fed. x Giza 129 cultivar) in the 1st season. Hence, the results may be due to the genetic variation among varieties under various nitrogen fertilizer quantities reflecting weather climatic condition.

Table 6. Interaction of nitrogen fertilizers and cultivars (N x Cv.) on the plant height, yield components and yield for barley in the first and second seasons.

Characters / Interaction (N x Cv.)		Plant height (cm)		Spike length (cm)		Number of spikes/m^2		1000 grain weight (g)		Grain yield/fed. (ard.)	
		2013/14	2014/15	2013/14	2014/15	2013/14	2014/15	2013/14	2014/15	2013/14	2014/15
N_1	Cv.1	118.7	118.1	7.38	7.13	522.0	459.1	70.86	70.22	12.11	15.77
	Cv.2	114.7	100.0	8.10	7.51	504.4	452.0	59.35	60.45	11.07	12.57
	Cv.3	113.6	110.6	7.80	7.18	476.4	369.0	63.54	62.89	11.92	13.28
N_2	Cv.1	119.1	120.3	7.26	7.13	592.7	470.0	71.10	71.22	15.66	15.86
	Cv.2	120.7	104.3	8.29	7.23	509.2	428.7	59.47	59.54	10.43	13.73
	Cv.3	122.9	108.2	7.89	7.33	463.3	427.8	64.60	64.67	11.63	12.94
N_3	Cv.1	118.9	118.7	7.93	6.95	511.6	412.8	68.03	68.11	13.13	14.71
	Cv.2	123.3	117.4	8.59	6.85	526.7	487.6	58.88	62.22	9.90	13.96
	Cv.3	122.1	111.2	8.13	7.30	465.3	421.8	60.43	60.11	11.63	9.90
F - test		**	**	N.S.	N.S.	**	**	N.S.	**	**	**
LSD 5 %		3.9	5.2	-	-	41.2	34.6	-	1.93	1.24	1.6

N_1= 50 kg N/fed., N_2= 70 kg N/fed., N_3= 90 kg N/fed., Cv.1= Giza 123, Cv.2= Giza 129 and Cv.3= Giza 130

*, ** indicated to significantly and highly significantly at 5% and 1% levels of probability, respectively.

N.S. = Non-significant differences. LSD= Least Significant Difference.

Table 7. Interaction between sowing dates x nitrogen fertilizer x cultivars (SxNxCv.) on the plant height, yield components and yield for barley in the third and second seasons.

Interaction (S x N x Cv.) / Characters			Plant height (cm)		Spike length (cm)		Number of spikes/m^2		1000 grain weight (g)		Grain yield/fed. (ard.)	
S_1	N_1	Cv.1	126.7	118.3	7.47	6.80	513.3	530.0	68.67	68.00	11.11	13.17
		Cv.2	127.3	102.7	8.08	6.46	470.0	402.7	64.72	63.67	13.25	13.10
		Cv.3	122.0	118.3	7.98	6.16	373.3	374.0	66.13	66.33	9.67	11.30
	N_2	Cv.1	119.7	118.0	7.00	6.80	499.7	516.7	71.63	71.00	15.97	12.30
		Cv.2	129.3	104.7	8.65	6.56	455.0	398.3	61.07	59.00	11.97	11.50
		Cv.3	122.0	107.7	8.96	7.16	436.7	380.0	65.67	68.33	11.65	8.97
	N_3	Cv.1	114.7	113.7	8.80	6.60	460.0	433.3	69.40	71.67	12.20	13.00
		Cv.2	130.0	117.7	9.13	6.40	500.0	476.7	63.47	68.00	9.60	16.03
		Cv.3	127.0	114.3	7.61	7.16	416.0	419.0	65.80	67.67	11.65	8.97
S_2	N_1	Cv.1	116.7	124.7	7.43	7.03	439.3	417.3	74.90	75.00	13.70	18.17
		Cv.2	123.7	131.0	8.23	8.06	543.3	546.7	61.00	62.67	10.43	15.47
		Cv.3	119.3	126.0	7.62	7.83	473.3	368.0	63.83	63.67	12.87	17.37
	N_2	Cv.1	124.3	132.3	7.73	7.36	658.3	493.3	72.67	72.67	17.90	17.97
		Cv.2	111.3	119.3	8.00	7.20	480.0	502.7	61.67	60.00	10.00	18.70
		Cv.3	119.3	127.0	7.79	6.90	446.7	516.7	60.47	60.00	14.03	14.27
	N_3	Cv.1	122.3	130.3	7.32	6.83	468.0	481.7	75.03	75.00	15.57	17.03
		Cv.2	126.3	130.0	9.42	6.66	580.0	454.7	60.17	61.00	10.32	15.27
		Cv.3	126.7	133.0	7.93	7.16	483.3	466.7	58.83	59.00	14.63	12.30
S_3	N_1	Cv.1	112.7	111.3	7.23	7.56	613.3	430.0	69.00	67.67	11.53	15.97
		Cv.2	93.0	66.3	8.00	8.00	500.0	406.7	52.33	55.00	9.53	9.13
		Cv.3	99.3	87.3	7.80	7.56	582.7	365.0	60.67	58.67	13.23	11.17
	N_2	Cv.1	113.3	110.7	7.06	7.23	620.0	400.0	69.00	70.00	13.10	17.30
		Cv.2	121.3	89.0	8.23	7.93	592.7	385.0	55.67	59.67	9.33	11.00
		Cv.3	127.3	90.0	6.93	7.93	506.7	386.7	67.67	65.67	10.70	9.30
	N_3	Cv.1	119.7	112.0	7.66	7.43	606.7	323.3	59.67	57.70	11.63	14.10
		Cv.2	113.7	104.7	7.23	7.50	500.0	531.3	53.00	57.67	9.77	10.57
		Cv.3	112.7	86.3	8.86	7.56	496.7	379.7	56.67	53.67	8.60	8.43
F - test			**	**	**	N.S.	**	**	*	**	**	**
LSD 5 %			6.8	9.0	0.85	-	71.4	60.0	4.78	3.34	2.15	2.78

Shafi *et al*. (2011) concluded that the tallest plants was observed in local variety. Similar findings were declared by Zeidan (2007), Noworolnik *et al*. (2009), Aghdam and Samadiyan (2014) and Gezahegen and Kefale (2016).

With attention to the second order interaction (sowing dates x nitrogen fertilizer x cultivars), the data in Table 7 revealed that the all studied traits exerted highly significantly influence by the interactions among sowing dates x nitrogen fertilizers x cultivars (SxNxCvs.) in the both seasons, except spike length in the 2nd season did not significant influenced by this interaction. The heaviest 1000 grain (75.03 and 75.0 g) were recorded by $S_2xN_3xCv.1$ (20th Dec. x 90 kg N/fed. x Giza 123 cultivar) in the both seasons. Moreover, the maximum grain yield/fed. (17.90 and 18.70 ard.) were recorded by $S_2xN_2xCv.1$ and $S_2xN_2xCv.2$), the greatest number of spikes/m^2 (620.0 and 546.7) were recorded by $S_3xN_2xCv.1$ and $S_2xN_1xCv.2$) and the tallest plants (130.0 and 133.0 cm) were recorded by $S_1xN_3xCv.2$ and

$S_2xN_3xCv.3$) in the 1st and 2nd seasons, respectively. On the other hand, the shortest plants (93.0 and 66.3 cm) were achieved by $S_3xN_1xCv.2$ (10th Jan. x 50 kg N/fed. x Giza 129 cultivar) in the both seasons. Moreover, the minimum grain yield/fed. (8.60 and 8.34 ard.) in the both seasons and the thinnest 1000 grain (53.67 g) in the 2nd season were achieved by $S_3xN_3xCv.3$ (10th Jan. x 90 kg N/fed. x Giza 130 cultivar), as well as the lowest number of spikes/m^2 (323.3) in the 2nd season and the thinnest 1000 grain (53.00 g) in the 1st season were achieved by $S_3xN_3xCv.1$ and $S_3xN_3xCv.2$, respectively. Here, this result means the three cultivars had different behavior under agricultural practices for this investigation reflecting the genetic make up.

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استجابة بعض أصناف الشعير لمواعيد الزراعة المتأخرة ومعدلات السماد النيتروجيني تحت ظروف الوادي الجديد

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الملخص

أقيم هذا البحث في واحدة الداخلة بمحافظة الوادي الجديد خلال موسمي الزراعة ٢٠١٣/٢٠١٤ و ٢٠١٤/٢٠١٥ لدراسة استجابة بعض أصناف الشعير لمواعيد الزراعة المتأخرة ومعدلات السماد النيتروجيني تحت ظروف الوادي الجديد. نفذت ثلاث تجارب منفصلة لكل ميعاد زراعي وهي الزراعة أول ديسمبر، ٢٠ ديسمبر و ١٠ يناير (S_1, S_2 and S_3) في كلا الموسمين. وكان التصميم هو القطاعات الكاملة العشوائية باستخدام الأحواض المنشقة مرة واحدة في ثلاث مكررات، حيث تم وضع معدلات السماد النيتروجيني (٥٠ ، ٧٠ و ٩٠ كجم ن/فدان) في القطع الرئيسية ، بينما تم وضع أصناف الشعير (جيزة ١٢٣ ، جيزة ١٢٩ وجيزة ١٣٠) في القطع المنشقة مرة واحدة. وكانت مساحة القطعة التجريبية ١٠,٥ م٢ (٣ × ٣,٥ م = ١/٤٠٠ فدان).

ويمكن تلخيص أهم النتائج المتحصل عليها كما يأتي:

- سجل ميعاد الزراعة أول ديسمبر أعلي متوسطات القيم لطول النبات وطول السنبلة في الموسم الأول ووزن ١٠٠٠ حبة في كلا الموسمين، علاوة علي ذلك سجلت أطول النباتات وأعظم عدد السنابل/م٢ في الموسم الثاني وأعلي محصول حبوب/فدان في ميعاد الزراعة ٢٠ ديسمبر.
- تفوق الصنف جيزة ١٢٣ علي الصنفين جيزة ١٢٩ وجيزة ١٣٠ وأعطي أعلي متوسطات القيم لوزن ١٠٠٠ حبة ومحصول الحبوب/فدان في كلا الموسمين وعدد السنابل/م٢ وطول النبات في الموسم الأول والثاني علي الترتيب، بينما أعطي الصنف جيزة ١٢٩ أطول النباتات وأعظم عدد سنابل/م٢ في الموسم الأول والثاني علي الترتيب.
- أعطت معاملات التفاعل S_3xN_1 (١٠ يناير × ٥٠ كجم ن/فدان) أقل القيم لطول النبات في كلا الموسمين وعدد السنابل/م٢ في الموسم الأول كما أعطي معاملات التفاعل S_3xN_3 (١٠ يناير × ٩٠ كجم ن/فدان) أقل القيم لوزن ١٠٠٠ حبة ومحصول الحبوب/فدان في كلا الموسمين، ورغم ذلك حصل علي أعلي القيم لوزن ١٠٠٠ حبة ومحصول الحبوب/فدان لمعاملات التفاعل $S_2xCv.1$ (٢٠ ديسمبر × الصنف جيزة ١٢٣) ومعاملات التفاعل $N_2xCv.1$ (٧٠ كجم ن/فدان × الصنف جيزة ١٢٣) في كلا الموسمين.
- تحقق أعلي قيم المتوسطات لوزن ١٠٠٠ حبة ومحصول الحبوب/فدان في كلا الموسمين، وأعلي القيم لعدد السنابل/م٢ في الموسم الثاني بمعاملات التفاعل $S_2xN_3xCv.1$ (٢٠ ديسمبر × ٩٠ كجم ن/فدان × الصنف جيزة ١٢٣).