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INFLUENCE OF NITROGEN LEVEL AND ITS APPLICATION TIME ON YIELD AND QUALITY OF SOME NEW HULL- LESS BARLEY

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ABSTRACT

Two field trials were conducted at the extension field in Shieba village, Zagazig. Destrict (Sharkia Governorate) during 2001/2002 and 2002/2003 growing seasons to study the effect of nitrogen levels (zero, 40 and 80 kg N/fed.) and timing of application (once full, two and three equal doses) on yield and its attributes and quality of hull-less barley cultivars (Giza 129, Giza 130 and Giza 131).

The results show that, barley cultivars differed significantly regarding their plant height, flag leaf area, spike length, number of grains/spike, protein %, biological yield (ton /fed) and harvest index.

The increase of nitrogen level up to 80 kg N/ fed produced significant increases in grain yield (ton/fed.), protein content % and almost of all yield attributes. Also, the application of nitrogen in three equal doses (at sowing, at tillering and jointing stages) recorded the highest average values of yield and its attributes.

The interaction between barley cultivars and nitrogen levels was significant and showed that grain yield of Giza 131 CV. exhibit in the highest response grain yield/fed to the increase of N level and splitting of N doses compared to the other cultivars

The results indicated that grain yield/fed was positively and highly significantly correlated with almost studied traits including number of grains/spike, weight of grains/plant, number of spikes/m^2, 1000-grain weight and protein content %.

Path analysis revealed that the main sources of grain yield variation according to their relative importance were number of grains/spike, number of spikes /m^2 and 1000-grain weight, since the direct and indirect effects of these characters contributed more than 64.21 % from the variation of grain yield.

INTRODUCTION

Barley *(Hordeum vulgare L.)* is one of the most important winter crops grown for green forage as for feeding animals on its straw beside grains, also as a food by Arabian tribes who live in the desert and in dry regions for making bread, either alone or mixed with wheat. Also, it could be used for malting in the brewing industry.

Barley is the main cereal crop in the poor land, most of these lands are suffering from nitrogen deficiency.

Nitrogen has provide to be the most limiting factor to work agriculture especially in the drier regions. It is easily to be lost from the soil through leaching and cropping. Many areas have to be more preferable to use split nitrogen fertilizer at various growth stages to increase grain yield and quality of barley.

Several workers reported that barley cultivars showed significant differences in yield and yield attributes (Noaman *et al.*, 1995; Gomaa, 1997; El-Hindi *et al.*, 1998; El-Bawab, 1999; Abdel-Hamid and Mohamed, 2000; El-Bawab *et al.*, 2003; Ahmed *et al.*, 2003 and Abd El-Maksoud and Maha, 2003). On the other hand, Jha *et al.*,1981; Noworolnik and Pecio, 1989 and Abdel-Hamid *et al.*, 2001 stated insignificant differences between barley cultivars for grain yield and protein.

The response of barley plants to increase nitrogen application was studied by many workers. El-Hindi *et al.*, 1998 and El-Kholy and El-Bawab, 1998 found that nitrogen increased plant height, number of spikes /m^2, number of grains / spike, weight of grains / spike, 100-grain weight, grain yield, grain protein content. Abdel- Hamid and Mohamed (2000) reported that nitrogen fertilizer significantly affected yield and yield attributes of barley. El-Bawab *et al.* (2003) showed that barley yield responded to nitrogen level up to 45-75 kg N/ fed through increasing the most of yield and yield attributes studied.

Regarding to splitting nitrogen application, Harris (1986) found that delaying N-application led to lower yield and increased grain protein content. Basha and El- Bana (1994) reported that splitting N rates into three equal doses significantly increased number of tillers and spikes /m^2, grain yield / fed as well as straw and biological yield / fed while, applied N in four equal doses produced lower straw and biological yields / fed. Ibrahim and Gendy (1996) showed that splitting N rates into three doses increased yield and yield attributes and protein percentage. Saleh (2003) found that application of nitrogen in four or five equal doses had favorable effect on number of grains/spike, grain yield and its attributes, except 1000-grain weight. Abd El-Maksoud and Maha (2003) reported that all studied traits positively responded to splitting N fertilizer, where as splitting N rates into six doses gave the best results followed by five doses and seven doses for the most traits under the study. This investigation aimed to study the influence of nitrogen level and timing of application on yield and quality of some barley hull-less cultivars.

MATERIALS AND METHODS

A field experiment was conducted at the administration field at Shieba village, Zagazig. District, Sharkia Governorate, during two winter seasons (2001/2002) and (2002/2003). The soil of the experimental site is clay in texture, it had an average pH value of 7.83 and organic matter content of 1.571%. The available N, P and K contents were 0.144, 0.022 and 0.028 ppm, respectively (averaged over the two seasons for the upper 25 cm of soil depth). The experiment included 27 treatments, which were the combinations of:

A-Three cultivars : Giza 129, Giza 130 and Giza 131.

B- Three nitrogen levels :

1-Without application (Zero).
2- 40 kg N / fed.
3- 80 kg N / fed.

C- Three splitting treatments of N:

1- Once application at sowing (S_0).
2- Two equal splits given at sowing and tillering stage (S_1).
3- Three equal splits given at sowing, tillering stage and jointing stage (S_2).

Barley cultivars were sown in rows on December 10^{th} and 15^{th} in the first and second seasons, respectively. The experimental field was fertilized with calcium super phosphate (15.5% P_2O_5) at a rate of 100 kg / fed before sowing. Urea (46.5% N) was the source of nitrogen applied. The normal cultural practices of growing barley were followed.

A split- split plot design with three replications was used with sub-subplot area of 9^2 having 15 rows with three m long and 20 cm between rows. The three cultivars were assigned to the main plots, the sub-plots included three levels of nitrogen and the sub-sub-plots included three splits of nitrogen treatments.

Data collected:

Ten seedlings were labled at seedling stage from each sub- sub plot for recording yield attributes at harvest and the following characters were determined:

1-Plant height (cm).
2-Number of tillers /plant.
3-Number of spikes / plant.
4-Flag leaf area (cm^2).
5-Spike length.
6-Number of grains / spike.
7- Grain weight / plant (gm).
8- 1000-grain weight (gm).
9-1000-grain volume (ml).

In addition, the central two rows of each plot were harvested to measure:

1- Number of spikes/m^2.
2- Grain yield (ton/fed).
3- Straw yield (ton/fed).
4- Biological yield (ton/fed).
5- Harvest index.
6- Protein content %.

The micro-Kjeldahl method was used to determine grain nitrogen content which was multiplied by factor 5.75 to obtain the percentage of crude protein according to A. O. A. C. (1980).

7- Carbohydrate content % was determined according to Dubois *et al.* (1956).

The obtained data were statistically analyzed according to Snedcor and Cochran (1981). The combined analysis of variance of the two seasons was used. Analysis of variance of the two seasons was used to calculate the simple correlation coefficients and path analysis as described by Svab (1973).

RESULTS AND DISCUSSION

I- Varietal differences:

Highly significant differences were detected among barley cultivars in their, plant height, flag leaf area, spike length, number of grains/spike and weight of grains/spike in both seasons and the combined. Also, barley cultivars showed significant differences in straw yield, biological yield, harvest index and protein percentage during the second season and the combined (Tables 1, 2, 3 and 4). Relevant results indicated that Giza130 was superior to the other cultivars in plant height, Flag leaf area, spike length. While, Giza 129 produced the highest number of grains/spike, straw and biological yields (ton /fed). However, Giza 131 gave the highest harvest index, and protein content percentage. But, the differences did not reach the level of significance between Giza 130 and Giza 131, except for protein percentage.

On the other hand, insignificant differences could be detected among the three barley cultivars concerning number of tillers / plant, number of spikes / plant, weight of grains / plant, 1000- grain weight and volume, carbohydrate content percentage and grain yield (ton / fed). These results are in a good line with those reported by Noworolink and Pecoi, 1989; El- Kholy and El- Bawab, 1998; El-Hindi *et al.*, 1998; Abdel-Hamid and Mohamed, 2000 and El-Bawab *et al*, 2003.

2- Effect of nitrogen levels:

Data (Tables 1, 2, 3 and 4) indicated that application of nitrogen fertilizer up to 80 kg N/fed increased significantly differences in plant height, spikes/ plant, flag leaf area, spike length, number of grains/spike, weight of grains/plant, number of spike/m^2, 1000-grain weight and volume, carbohydrate %, protein % and grain and biological yields (ton / fed) in both seasons and combined. The relative increases due to increasing nitrogen from zero up to 80 kg N/fed for these characters were, 12.83%, 6.53%, 7.17%, 29.27%, 11.14%, 25.02%, 39.61%, 3.12%, 8.57%, 23.56%, 14.87%, 7.85% and 7.88%, respectively. These observations might be attributed to the favorable role of N in raising metabolites and their storage during the periods of physiological activity and filling period of barley plants (Stark and Brown, 1987 and Conry, 1995). However, the differences for nitrogen fertilization did not reach the level of significance for number of tillers/ plant in both seasons, straw yield (ton /fed) and harvest index in both seasons and the combined. These results are in agreement with those obtained by Osman *et al.*, 1991; Basha and El-Bana, 1994; El- Kholy and El- Bawab, 1998; Abdel-Hamid *et al.*, 2001; Megahed, 2003 and El- Bawab *et al.*, 2003.

3-Effect of splitting nitrogen fertilizer:

The results presented in tables (1,2,3 and 4) indicated that splitting of nitrogen showed highly significant effects on most studied characters. A application of nitrogen in three equal doses (1/3 at sowing +1/3 at tillering and 1/3 at jointing stage) exceeded those obtained from the other two systems of nitrogen application in plant height, number of tillers and spikes/plant, flag leaf area, spike length, number and weight of grains/plant, number of spikes /m^2, 1000-grain weight and volume, protein %, grain yield, straw yield and biological yield (ton /fed). Furthermore, the differences among the three systems of adding nitrogen fertilizer were not great enough to reach the significance in carbohydrate % in both seasons and combined. Also, harvest index followed the same trend in the first season and the combined.

Table (1): Plant height (cm), Number of tillers plant, number of spikes / plant and flag leaf area (cm^2) as affected by studied treatments for two seasons and combined analysis.

Treatments and interaction	Plant height (cm)			Number of tillers / plant			Number of spikes / plant			Flag leaf area (cm^2)		
	First season	Second season	Comb.	First season	Second season	Comb.	First season	Second season	Comb.	First season	Second season	Comb.
Cultivars (C):												
Giza.129	90.49^{b}	93.53^{b}	92.01^{c}	4.91	4.85	4.88	4.90	4.84	4.87	9.95^{b}	9.03^{b}	9.49^{b}
Giza.130	107.87^{a}	112.6^{a}	110.23^{a}	4.97	4.89	4.93	4.89	4.86	4.87	12.21^{a}	11.15^{a}	11.68^{a}
Giza.131	106.03^{a}	108.18^{a}	107.17^{b}	4.92	4.83	4.88	4.89	4.78	4.83	11.97^{a}	11.26^{a}	11.62^{a}
F. Test	**	**	**	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	**	**	**
Nitrogen fertilizer (N):												
Zero	93.40^{c}	98.22^{c}	95.81^{c}	4.74	4.69	4.72^{b}	4.68^{b}	4.65^{b}	4.66^{b}	9.16^{b}	8.63^{c}	8.89^{c}
40 Kg/fad	101.54^{b}	105.70^{b}	103.62^{b}	4.95	4.90	4.93^{ab}	4.90^{ab}	4.87^{ab}	4.89^{ab}	12.22^{a}	10.42^{b}	11.32^{b}
80 Kg /fad	109.45^{a}	110.40^{a}	109.92^{a}	5.12	4.98	5.05^{a}	5.10^{a}	4.95^{a}	5.02^{a}	12.75^{a}	12.39^{a}	12.57^{a}
F. Test	**	**	**	N.S.	N.S.	*	*	*	*	**	**	**
Split of nitrogen (S):												
Once application (S_0)	99.12^{c}	102.29^{c}	100.70^{c}	4.43^{c}	4.49^{c}	4.46^{c}	4.40^{c}	4.46^{c}	4.43^{c}	10.16^{c}	9.50^{c}	9.83^{c}
Two equal dose (S_1)	101.81^{b}	104.73^{b}	103.27^{b}	5.02^{b}	4.87^{b}	4.95^{b}	4.96^{b}	4.86^{b}	4.91^{b}	11.40^{b}	10.49^{b}	10.94^{b}
Three equal dose (S_2)	103.46^{a}	107.30^{a}	105.38^{a}	5.36^{a}	5.22^{a}	5.23^{a}	5.30^{a}	5.15^{a}	5.23^{a}	12.57^{a}	11.46^{a}	12.01^{a}
F. Test	**	**	**	**	**	**	**	**	**	**	**	**
Interaction:												
C X N	**	**	**	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	**	N.S.	**
C X S	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
N X S	**	N.S.	**	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	*	**
C X N X S	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

Table (2): Spike length (cm), Number of grains /spike, weight of grains / plant (gm) and number of spikes/ m^{2} as affected by studied treatments for two seasons and combined analysis.

Treatments and interaction	Spike length (cm)			Number of grains / spike			Weight of grains / Plant (gm)			Number of spikes/m^{2}		
	First season	Second season	Comb.	First season	Second season	Comb.	First season	Second season	Comb.	First season	Second season	Comb.
Cultivars (C):												
Giza.129	6.81^{b}	6.76^{b}	6.78^{b}	42.93^{a}	41.72^{a}	42.32^{a}	9.86^{b}	10.65	10.26	356.63	365.11^{a}	360.87
Giza.130	7.52^{a}	7.08^{a}	7.12^{a}	41.56^{b}	40.20^{b}	40.88^{b}	10.98^{a}	9.90	10.44	349.89	345.48^{b}	347.69
Giza.131	7.07^{a}	7.05^{a}	7.06^{a}	40.86^{b}	40.65^{b}	40.75^{b}	10.38^{b}	10.48	10.43	357.44	352.30^{b}	354.87
F. Test	*	*	**	*	**	**	**	N. S.	N. S.	N.S.	*	N.S.
Nitrogen fertilizer (N):												
Zero	6.63^{c}	6.46^{c}	6.54^{c}	35.31^{c}	34.64^{c}	34.97^{c}	7.72^{c}	7.34^{c}	7.53^{c}	348.30	348.11^{b}	348.20^{b}
40 Kg/fad	7.13^{b}	6.99^{b}	7.06^{b}	42.37^{b}	42.31^{b}	42.34^{b}	11.16^{b}	11.08^{b}	11.12^{b}	356.33	355.22^{a}	355.8^{ab}
80 Kg /fad	7.27^{a}	7.44^{a}	7.36^{a}	47.66^{a}	45.62^{a}	46.64^{a}	12.34^{a}	12.60^{a}	12.47^{a}	359.33	359.56^{a}	359.44^{a}
F. Test	**	**	**	**	**	**	**	**	**	N.S.	**	*
Split of nitrogen (S):												
Once application (S_0)	6.71^{c}	6.64^{c}	6.67^{c}	40.64^{c}	39.58^{c}	40.11^{c}	9.02^{c}	9.23^{c}	9.12^{c}	340.93^{c}	336.52^{c}	338.72^{c}
Two equal dose (S_1)	6.96^{b}	6.92^{b}	6.94^{b}	41.90^{b}	41.04^{b}	41.47^{b}	10.31^{b}	10.38^{b}	10.34^{b}	353.26^{b}	355.89^{b}	354.57^{b}
Three equal dose (S_2)	7.36^{a}	7.33^{a}	7.34^{a}	42.81^{a}	41.95^{a}	42.38^{a}	11.90^{a}	11.42^{a}	11.66^{a}	369.78^{a}	370.48^{a}	370.13^{a}
F. Test	**	**	**	**	**	**	**	**	**	**	**	**
Interaction:												
C X N	N.S.	*	N.S.	**	**	N.S.	N. S.	N. S.	**	N.S.	N.S.	*
C X S	N.S.	**	**	N.S.	N.S.	**	N. S.	N. S.	*	N.S.	N.S.	*
N X S	N.S.	N.S.	*	**	**	**	**	**	N. S.	N.S.	N.S.	N.S.
C X N X S	N.S.	N. S.	N. S.	N. S.	N. S.	*	*	N. S.	*	N.S.	N.S.	N.S.

Table (3): Thousand-grain weight (gm), 1000-grain volume (cm^3), carbohydrate and protein % as affected by studied treatments for two seasons and combined analysis.

Treatments and interaction	1000-Grain weight (gm)			1000-grain volume (cm^3)			Carbohydrate %			Protein %		
	First season	Second season	Comb.	First season	Second season	Comb.	First season	Second season	Comb.	First season	Second season	Comb.
Cultivars (C):												
Giza.129	35.61	37.36	36.48	15.67	16.22	15.94	48.19	47.41	47.80	10.98	10.86^{b}	10.92^{b}
Giza.130	36.12	37.73	36.93	17.30	16.70	17.00	47.30	47.15	47.22	10.98	10.77^{b}	10.87^{b}
Giza.131	35.64	37.04	36.34	16.52	17.07	16.80	47.33	48.22	47.78	11.12	11.22^{a}	11.17^{a}
F. Test	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	**	**
Nitrogen fertilizer (N):												
Zero	34.09^{c}	35.44^{b}	34.77^{c}	14.48^{b}	14.52^{b}	14.50^{b}	40.44^{c}	41.63^{c}	41.04^{c}	10.22^{b}	9.91^{c}	10.07^{b}
40 Kg /fad	36.00^{b}	37.91^{a}	36.95^{b}	17.30^{a}	17.44^{a}	17.37^{a}	48.22^{b}	47.93^{b}	48.07^{b}	11.08^{c}	11.06^{b}	11.07^{b}
80 Kg /fad	37.29^{a}	38.78^{a}	38.03^{a}	17.70^{a}	18.04^{a}	17.87^{a}	54.15^{a}	53.22^{a}	53.69^{a}	11.77^{a}	11.88^{a}	11.83^{a}
F. Test	**	**	**	*	**	**	**	**	**	**	**	**
Split of nitrogen (S):												
Once application (S_0)	32.81^{c}	35.92^{c}	34.36^{c}	14.96^{c}	14.42^{c}	14.69^{c}	47.63	47.04	47.33	10.57^{c}	10.58^{c}	10.58^{c}
Two equal dose (S_1)	36.20^{b}	37.34^{b}	36.77^{b}	16.56^{b}	16.67^{b}	16.61^{b}	47.30	47.52	47.41	11.10^{b}	10.90^{b}	11.00^{b}
Three equal dose (S_2)	38.37^{a}	38.87^{a}	38.62^{a}	17.96^{a}	18.93^{a}	18.44^{a}	47.89	48.22	48.06	11.40^{a}	11.36^{a}	11.38^{a}
F. Test	**	**	**	**	**	**	N.S.	N.S.	N.S.	**	**	**
Interaction:												
C X N	N.S.	N.S.	*	N.S.	N.S.	*	N.S.	N.S.	N.S.	**	**	**
C X S	N.S.	N.S.	*	N.S.	N.S.	*	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
N X S	N.S.	**	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
C X N X S	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	**	**

Table (4): Grain yield (ton/fad), straw yield (ton/fad), biological yield (ton/fad) and harvest index as affected by studied treatments for two seasons and combined analysis.

Treatments and interaction	Grain yield (ton/fad)			Straw yield (ton/fad)			Biological yield (ton/fad)			Harvest index		
	First season	Second season	Comb.	First season	Second season	Comb.	First season	Second season	Comb.	First season	Second season	Comb.
Cultivars (C):												
Giza.129	1.84	1.79	1.82	2.27	2.59^{a}	2.43^{a}	4.12	4.38^{a}	4.25^{a}	44.58	40.10^{b}	42.34^{b}
Giza.130	1.87	1.74	1.81	1.99	1.99^{b}	1.99^{b}	3.87	3.73^{b}	3.80^{b}	48.38	46.65^{ab}	47.51^{a}
Giza.131	1.81	1.94	1.87	1.84	1.85^{b}	1.84^{b}	3.65	3.78^{b}	3.72^{b}	49.60	51.19^{a}	50.40^{a}
F. Test	N.S.	N.S.	N.S.	N.S.	**	**	N.S.	**	**	N.S.	*	**
Nitrogen fertilizer (N):												
Zero	1.79^{b}	1.72^{b}	1.76^{c}	1.94	2.02	1.98	3.74^{b}	3.74^{b}	3.74^{b}	47.97	46.02	46.99
40 Kg/fad	1.83^{a}	1.83^{a}	1.83^{b}	2.07	2.18	2.13	3.90^{ab}	4.01^{ab}	3.96^{a}	46.92	45.67	46.28
80 Kg /fad	1.91^{a}	1.91^{a}	1.91^{a}	2.09	2.22	2.16	3.10^{a}	4.13^{a}	4.06^{a}	47.67	46.25	46.96
F. Test	*	**	**	N.S.	N.S.	N.S.	*	*	**	N.S.	N.S.	N.S.
Split of nitrogen (S):												
Once application (S_0)	1.62^{c}	1.62^{c}	1.62^{c}	1.85^{b}	1.98^{b}	1.92^{b}	3.48^{c}	3.60^{c}	3.54^{c}	46.87	44.95^{b}	45.91
Two equal dose (S_1)	1.81^{b}	1.87^{b}	1.84^{b}	1.99^{b}	2.02^{b}	2.01^{b}	3.80^{b}	3.90^{b}	3.85^{b}	47.69	48.06^{a}	47.87
Three equal dose (S_2)	2.09^{a}	1.98^{a}	2.03^{a}	2.26^{a}	2.42^{a}	2.34^{a}	4.35^{a}	4.39^{a}	4.37^{a}	48.00	44.98^{b}	46.48
F. Test	**	**	**	**	**	**	**	**	**	N.S.	**	N.S.
Interaction:												
C X N	N.S.	N.S.	*	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	*	N.S.	N.S.
C X S	**	**	**	N.S.	**	N.S.	N.S.	**	**	N.S.	*	N.S.
N X S	N.S.	N.S.	N.S.	N.S.	**	*	N.S.	**	*	*	*	*
C X N X S	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

The two equal doses application produced high values with significant differences, concerning harvest index in the second season only. These results are in a good connection with those reported by Dawood *et al.*, 1988; Basha and El-Bana, 1994; Ibrahim and Gendy, 1996 and Abd El-Maksoud and Maha, 2003 who found that splitting N fertilizer tended to increase yield attributes and both protein and carbohydrate of barley.

4-Interaction effect:

Concerning the significant interaction between barley cultivars and nitrogen fertilization levels on weight of grain /plant, number of spikes/m^2, 1000- grain weight and grain yield (ton/ fed), response curves showed that increasing nitrogen level tended to produce higher values of yield components and grain yield (ton/fed), in the three barley cultivars which agreed with the main effects throughout the combined analysis.

It is evident from Figs 1, 2, 3 and 4 that weight of grains/plant, number of spikes/m^2 and 1000-grain weight continued to increase significantly with the increase of N fertilization level up to the addition of 80 kg N /fed. This was valid in the three barley cultivars. Hence, grain yield (ton/ fed) was increased in linear magnitude. Also, Giza 131 showed greater response to added N than the other two barley cultivars in grain yield (ton/fed).

Also, the response curves (Figs 5, 6, 7 and 8) showed that increasing splitting treatments tended to produce higher values of yield components and grain yield (ton/ fed), in the three barley cultivars.

It is evident from Figs. 5,6,7 and 8 that weight of grain / plant, number of spikes/m^2 and 1000-grain weight continued to increase significantly with splitting treatments. Hence, grain yield (ton/ fed) was increased in linear magnitude where, Giza 131 showed greater response to splitting than the other two barley cultivars.

5- Seed yield analysis:

5-a)- the correlation coefficients:

Grain yield was positively and highly significantly correlated with most characters studied (Table 5) i.e. number of spikes/plant, weight of grains/ plant, number of grains/spike, number of spikes/m^2, 1000-grain weight and protein content percentage. Also, number of spikes/plant showed positive and highly significant interrelationships with weight of grains/plant, number of spikes/m^2, 1000- grain weight and straw yield. Protein %, carbohydrate % and flag leaf area. However, the correlation coefficients between grain yield and each of plant height and carbohydrate % did not reach the level of significance. Similar results were obtained by Basha and El- Bana, 1994 and Gomaa, 1997.

5-b) Path analysis:

The direct and indirect effects of number of grains / spike, number of spikes /m^2 and 1000-grain weight, on grain yield variation. Table (6) showed that number of spikes/m^2 recorded the highest direct in this respect. Although the simple correlation coefficient between each of number of grains/spike ($r = 0.433$) was significant, the direct effect of this character was negative.

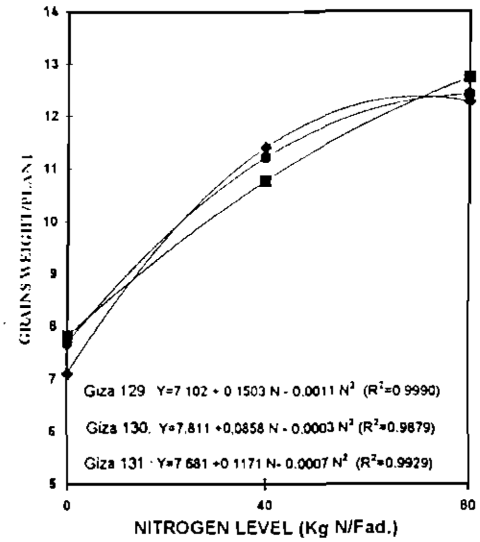

Fig.(1): Response of grains weight/plant in the three barley varieties under different N fertilizer levels (combined data)

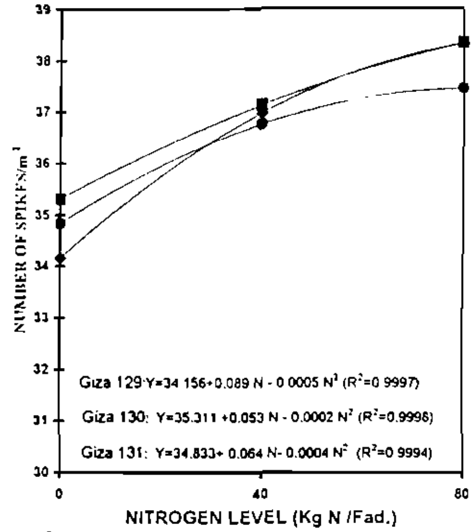

Fig.(2): Response of number of spikes/m 2 in the three barley varieties under different N fertilizer levels (combined data).

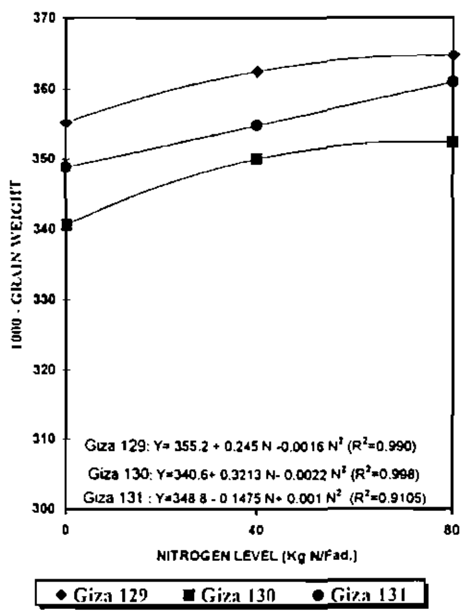

Fig.(3): Response of 1000 - grain weight in the three barley varieties under different N fertilizer levels (combined data)

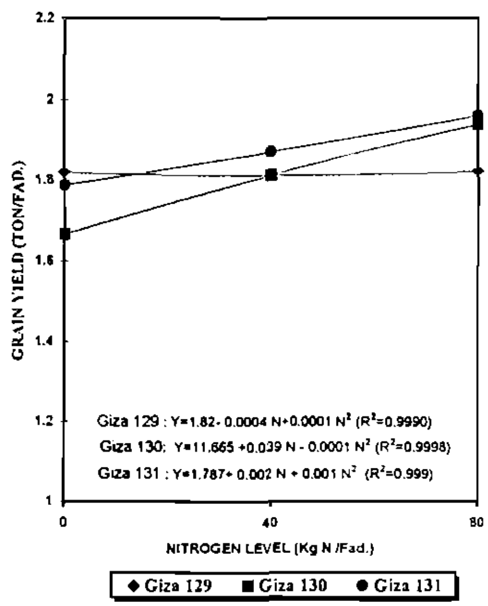

Fig.(4): Response of grain yield (ton/fad.) in the three barley varieties under different N fertilizer levels (combined data)

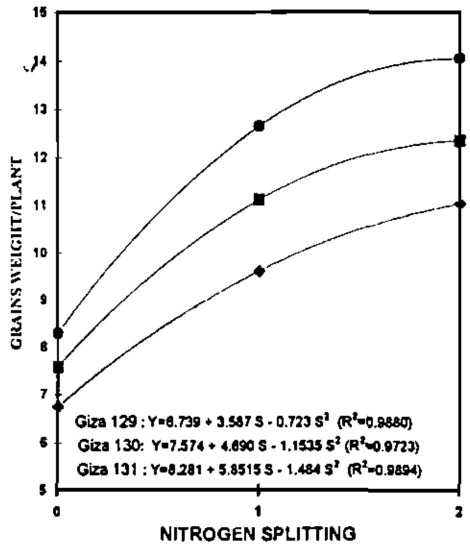

Fig.(5): Response of grains weight/plant in the three barley varieties under different N fertilizer splitings (combined data)

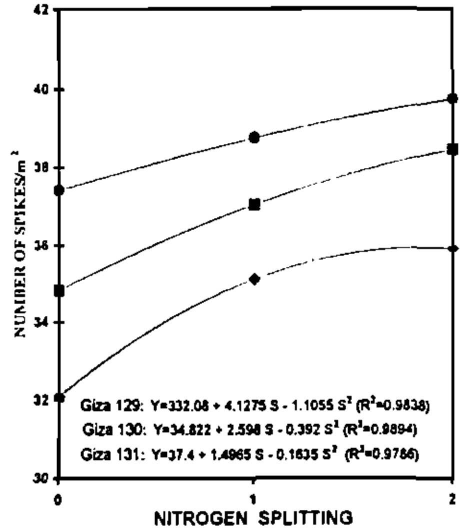

Fig.(6): Response of number of spikes/m2 in the three barley varieties under different N fertilizer splittings (combined data).

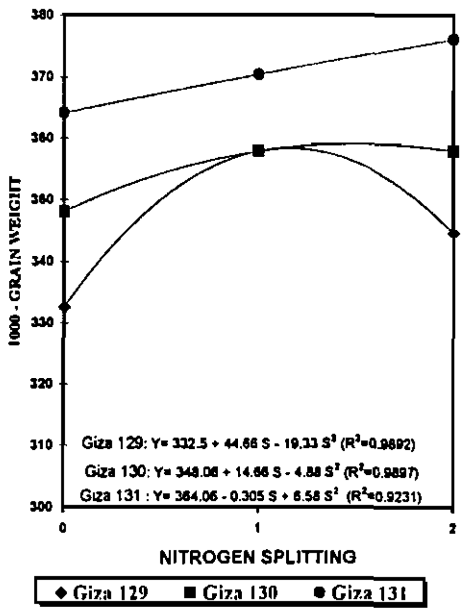

Fig.(7): Response of 1000 - grain weight in the three barley varieties under different N fertilizer splittings (combined data)

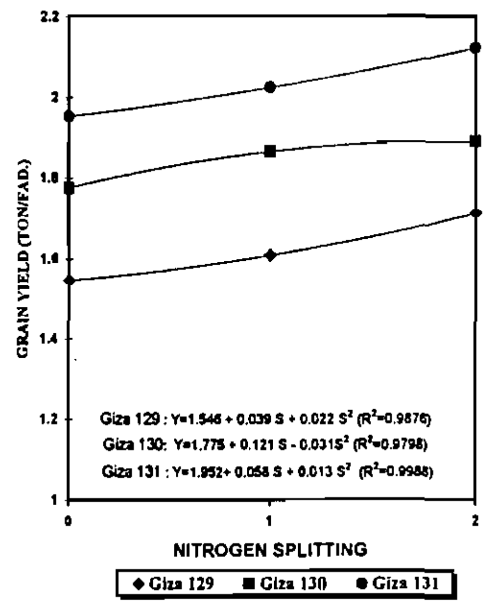

Fig.(8): Response of grain yield (ton/fad.) in the three barley varieties under different N fertilizer splittings (combined data)

Table 5: Simple correlation coefficients among grain yield /fed and its components of barley (the combined data).

Characters	1	2	3	4	5	6	7	8	9	10
Y- Grain yield /fed.	0.314^{NS}	0.827**	0.433*	0.628**	0.853**	0.792**	0.406*	0.666**	0.342^{NS}	0.529**
1-Plant height	-	0.369*	0.462*	0.590**	0.082^{NS}	0.523**	-0.267^{NS}	0.572**	0.530**	0.877**
2- Number of spikes/plant	-	-	0.547**	0.736**	0.863**	0.861**	0.474*	0.691**	0.407*	0.666**
3- Number of grains/spike	-	-	-	0.928**	0.503**	0.702**	0.388*	0.917**	0.955**	0.688**
4- Weight of grains/plant	-	-	-	-	0.633**	0.840**	0.367^{NS}	0.947**	0.863**	0.846**
5- Number of spikes/m^2	-	-	-	-	-	0.804**	0.681**	0.630**	0.363^{NS}	0.426*
6- 1000-grains weight	-	-	-	-	-	-	0.536**	0.803**	0.621**	0.763**
7- Straw yield /fad.	-	-	-	-	-	-	-	0.396^{NS}	0.283^{NS}	0.067^{NS}
8- Protein %	-	-	-	-	-	-	-	-	0.877**	0.789**
9- Carbohydrate %	-	-	-	-	-	-	-	-	-	0.960**
10- Flag leaf area	-	-	-	-	-	-	-	-	-	-

Table 6: Partitioning of simple correlation coefficients between grain yield (ton/fed) and its components of barley (combined of both seasons).

Sources	Values
Number of grains/spike	
Direct effect	-0.1721
Indirect effect via number of spikes/m^2	0.2926
Indirect effect via 1000-grain weight	0.3125*
Total (ry_1)	0.4330
Number of spikes/m^2	
Direct effect	0.5817
Indirect effect via number of grains/spike	-0.0865
Indirect effect via 1000-grain weight	0.3579
Total (ry_1)	0.8530**
1000-grains weight	
Direct effect	0.4451
Indirect effect via number of grains/spike	-0.1208
Indirect effect via number of spikes/m^2	0.4677
Total (ry_1)	0.7920**

Table 7: Direct and joint effects of grain yield components presented as percentage of variation of barley (combined of both seasons).

Source	C.D.	%
Number of grains/spike	0.0151	1.51
Number of spikes/m^2	0.1723	17.23
1000-grain weight	0.1009	10.09
Number of grains/spike x number of spikes/m^2	0.0513	5.13
Number of grains/spike x 1000-grain weight	0.0904	9.04
Number of spike/m^2 x 1000-grains weight	0.2121	21.21
R^2	0.6421	64.21
Residual	0.3579	35.79
Total	1.0000	100.00

	Direct	Indirect	Total
Number of grains/spike	1.51	7.085	8.595
Number of spikes/m^2	17.23	13.170	30.400
1000-grain weight	10.09	15.125	25.215
Total	28.83	35.38	64.21

C.D. =Coefficient determination, %= Percentage contributed

Therefore, the simple correlation coefficient is miss leading and partitioning of simple correlation coefficient must be done using path analysis.

The relative importance of the studied components to grain yield variation as percentage are shown in Table (7). It is clear that number of spikes/m^2 and 1000-grain weight as well, their interaction contributed as much to grain yield variation, since R^2 recorded heren was 64.21% of the total yield variation. However, the residual effect contributing to grain yield was being 35.79% of the total variation. The data obtained showed the most important sources of grain yield variation could be arranged according to their importance in the following order: Number of spikes/m^2 and 1000-grain weight and their interactions (number of spikes/m^2 X 1000-grain weight and number of grains/spike X 1000-grain weight). Since, their values were 17.23, 10.09, 21.21 and 9.04 % contributing to grain yield. Also, the total direct and indirect effects for number of spikes/m^2, 1000-grain weight and number of grains/spike (30.400, 25.125 and 8.595). From these results, it can be stated conveniently that improving the productivity of tested cultivars could be achieved when studied factors i.e., nitrogen fertilization and splitting fertilization directed to be active in increasing number of spikes/m^2, 1000-grain weight and number of grains/spike. These results are in agreement with those recorded by Basha and El-Bana (1994) and Gomaa (1997).

REFERENCES

Abdel-Hamid, M.; G. A. Mohamed and M. M. El-Koliey (2001). Evaluation of different species for biofertilizer and percentage for recommended rate applied nitrogen fertilizer on yield and yield components for some barley varieties. Egypt J. Appl. Sci., 16 (9): 120-131.

Abdel-Hamid, M. and G. A. Mohamed (2000). Effect of nitrogen fertilizer sources and moisture levels on yield and yield components of three barley varieties in middle Egypt. Egypt J. Appl. Sci., 15 (9): 92-103.

Abdel-Maksoud, M. F. and Maha, M. Abd-Alla (2003). Effect of sowing methods and splitting of nitrogen fertilizer on yield and its attributes of two barly cultivars under sandy soil. Proc. 10th Conf. Agron., Seuz Canal Univ., El-Arish, Egypt, 7-10 Oct.

Ahmed, I.A.; A. A. El-Sayed; R.A.Abo-El-El-Euin; A.S.El-Gamal; M. M. Noaman; A.M. El-Shebniny; F.A. Asaad; A. A. El-Hag; Kh. A. Moustafa; A. M. O. El-Bawab; M. A. El-Moselhy; M. A. Megahed; M. M. Abd El-Hamed; Kh. A. Amer; A. A. Attia; M. F. Saad; M. A. Said; M. A. Said; H. A. Ashmawy; R. A. rizk and H. A. T. Mahfouz (2003). Giza2000, A new Egyptian barley variety for newly reclaimed lands and rainfed areas. Zagazig J. Agric. Res., 30 (6): 2095-2112.

A. O. A. C. (1980). *Official Methods of Analysis Association of Official.* Agric. Chemists., Washington, D. C.

Basha, H. A. and A.Y. A. El-Bana (1994). Effect of nitrogen fertilization on barley in newly cultivated sandy soil. Zagazig J. Agric. Res., 20(4): 1053-1066.

Conry, M. J. (19954). A note the effect sowing date fertilizer nitrogen on the yield, grain nitrogen and screening content of spring-sown malting barley. Irish-Journal of Agriculture and Food Research, 34: 69-73.

Dawood, R. A.; K. A. Kheiralla and B. R. Bakheit (1988). Effect of N application at various growth stage on quantity and quality of barley. Assute J. of Agric. Sci., 19 (5): 181-193.

Dubois, M.; K. A. Gilles; J. Hamilton; R. Robers and F. Smith (1956). Calorimetric method for determination of sugar and related substances. Anul. Chem., 28: 350.

El-Bawab, A. M.O. (1999).Yield stability of some newly released barley cultivars in Egypt. Egypt. J. Appl. Sci., 14 (4): 128-136.

El-Bawab, A. M. O.: M. A. El-Moselhey and M. A. Megahed (2003). Water and nitrogen fertilizer requirements for barley in sandy soils Egypt J. Appl. Sci., 18 (7): 125-133.

El-Hindi, M. H.; A. T. El-Kassaby; A. E. Sharief and K. A. Amer (1998). Yield of barley as affected by different sources and levels of nitrogen fertilization under the environmental conditions of newly reclaimed soils at northern delta of Egypt. Proc. 8th Conf. Agron., Suez Canal, Univ., Ismailia, Egypt, 28-29 Nov., 153-158.

El-Kholy, M. A. and A. M. O. El-Bawab (1998). Response of some barley cultivars to nitrogen fertilization and Stimophol as a foliar application. Proc. 8th Conf. Agron., Suez Canal, Univ., Ismailia, Egypt, 28-29 Nov., 145-152.

Gomaa, M. M. (1997). Performance of three barley cultivars under varying seeding rates and NPK levels grown on sandy soil. Egypt. J. Appl. Sci., 12 (4): 186-199.

Harris, P. (1986). Refining winter wheat nitrogen recommendations. Arable Farming 13 (3): 85-86.

Ibrahim, M. E. and A. A. Gendy (1996). Effect of time of nitrogen application and growth retarding treatment on growth, phyt5ohormone concentration and yield of wheat. Zagazig J. Agric. Res., 23 (1): 1-28.

Jha, K. N. ; S. N. Ojha and B. D. Singh (1981). Response of barley varieties to levels of nitrogen under rainfed condition. Indian J. Agron. 26 (1): 97.

Megahed, A.M. (2003). Effect of seeding rates and nitrogen fertilizer levels on nearly Hull-less barley line under sprinkler irrigation system in poor sandy soils at Ismailia Governorate. Egypt J. Appl. Sci., 18 (2): 108-119.

Noaman, M. M.; A. A. El-Sayed; F. A. Asaad; A. M. El-Sherbini; A. O. El-Bowab; M. A. El-Moselhi and R. A. Rizk (1995). " Giza 125" and "Giza 126",two barley cultivars for rainfed areas of Egypt. Egypt J. Appl. Sci., 10 (7): 128-136.

Noworolink, K. and A. Pecio (1989). Effect of nitrogen fertilization on the productivity of new cultivars of winter barley. Pomietnk-Pulawasski (Poland). (1992).(No.95),60-82, Distributed.

Osman, A.O.;W.Kadry and M.A.Mahdy (1991). Barley plants influenced by N –sources, N-rate, Zinc and their combination. Egypt. J. Appl. Sci., 6 (12):446-455.

Saleh, M. E. (2003). Effect of level and splitting nitrogen on yield potentially of Sids$_1$ wheat cultivar. Zagazig J. Agric. Res., 30 (4): 1169-1188.

Stark, J. C. and B. D. Brown (1987). Estimating nitrogen requirement for irrigated malting barley. Communications in Soil Science and Plant Analysis, 8 (4): 433-444.

Snedecor, G. W. and W. G. Cochran (1981). *Statistical Methods.* 7th ed. Iowa State Univ. Press, Ames., Iowa, USA.

Svab, J. (1973). Biometriai medszerek a kutatasban-Mezogazdasagi kiado, Budapest.

تأثير مستوي النيتروجين وميعاد إضافته علي المحصول وجودته لبعض أصناف الشعير العارى

مها محمد عبد الله
قسم الثروة النباتية – معهد الكفاية الإنتاجية– جامعة الزقازيق

أقيمت تجربتان حقليتان خلال موسمي ٢٠٠١/ ٢٠٠٢ و٢٠٠٢/ ٢٠٠٣ بقرية شيبة بمحافظة الشرقية وذلك لدراسة تأثير مستويات النيتروجين (صفر ، ٤٠ و ٨٠ كجم ن /ف) وميعاد إضافة النيتروجين وتقسيمه (إضافة كاملة وقسمين متساويين وثلاثة أقسام متساوية) علي بعض أصناف الشعير العادي (جيزة ١٢٩ و جيزة ١٣٠ وجيزة ١٣١).

أظهرت النتائج أن هناك اختلافات معنوية لكل من صفات طول النبات ومساحة ورقة العلم وطول السنبلة وعدد الحبوب /السنبلة ومحتوي البروتين % ومحصول القش والمحصول البيولوجي طن/ف و دليل الحصاد.

كما أدت زيادة معدل النيتروجين لـ ٨٠ كجم /ف إلي زيادة معنوية في محصول الحبوب ومحتوي نسبة البروتين وكذلك أغلب مساهمات المحصول.

أيضا إضافة وتقسيم النيتروجين لثلاث جرعات متساوية (عند الزراعة وعند التفريع وعند الطرد) أعطت أعلي القيم للمحصول ومساهماته ماعدا دليل الحصاد ودليل المحصول لم يكن معنوي.

كما لوحظ تأثير معنوي لتداخل الفعل بين الأصناف ومستويات النيتروجين حيث اظهر الصنف جيزة ١٢٩ مع معدل ٨٠ كجم ن/ف أعلى القيم لكل من وزن حبوب النبات ووزن الألف حبة بينما كان الصنف جيزة ١٣١ اكثر استجابة مع زيادة النيتروجين لمحصول الحبوب / ف .

أظهرت نتائج تحليل الارتباط وجود علاقة موجبة ومعنوية بين محصول الحبوب / ف وكل من الصفات تحت الدراسة مثل عدد الحبوب / سنبلة ووزن حبوب النبات وعدد السنابل / م^{٢} ووزن الألف حبة ومحتوى نسبة البروتين.

كما أوضحت نتائج تحليل المرور أن المصادر الأساسية لإحداث التغير الناتج من محصول الحبوب /فدان هي عدد السنابل /م^{٢} وعدد الحبوب / سنبلة ووزن الألف حبة حيث ساهمت هذه المكونات وتفاعلاتها المباشرة والغير مباشرة بمقدار ٢١و٦٤% في التباين الكلي لمحصول حبوب الفدان.