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EFFECT OF NITROGEN FERTILIZATION ON YIELD, FLORAL FERTILITY AND INTER AND INTRA SPIKELET COMPETITIONS OF SOME WHEAT CULTIVARS IN SANDY SOILS

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ABSTRACT : Two field experiments were performed in the Experimental farm, Faculty of Agriculture, Zagazig University at Khattara, Sharkia Governorate, during 1999/2000 and 2000/2001 growing seasons under sprinkler irrigation in sandy soil to study the effect of four nitrogen fertilizer levels (30,60,90,and 120 kg N/fad.) on yield, floral fertility and inter and intra spikelet competitions of six bread wheat cultivars (Sids 5, Sids 8, Sids 9, Sids 10, Gemmiza 7 and Sakha 93). The obtained results could be summarized as follows :

(1) Wheat cultivars differed significantly regarding their flag leaf area and its chlorophyll content, as well as, grain and straw yields and all their attributes where Sids 9 followed by the other Sids cvs recorded higher grain but lower straw yield than Gemmiza 7 and Sakha 93.

(2) Wheat cultivars varied significantly regarding floral fertility where the Sids cvs set six grains compared to four only/spikelet in Gemmiza 7 and Sakha 93. Among the Sids cvs, Sids 5 and Sids 8 recorded heavier single grain weight at all spikelet positions along rachis and also for grain(b) along rachilla. The intra spikelet competition was much higher in the Sids cvs than in Gemmiza 7 and Sakha 93 due to the higher grain number/spike of the formers than in the latters.

(3) The increase of N level up to 120 kg N/fad. was followed by a significant increase in both grain and straw yields/fad. and almost all their attributes. This increase was attributed to the favourable

N effect on reducing the inter, and in particular, the intra – spikelet competitions.

(4) The increase of N level up to 90 kg N/fad. was in favour of grains in floral locations a, b, c and d along rachilla for all cultivars under study but was in favour of grain (e) and (f) in Sids cvs and in particular in Sids 5 and Sids 8.

(5) Significant cultivar response to N level was detected where the highest expected maximum yield of 1.998 ton/fad. could be obtained from Sids 5 due to the addition of 131.6 kg N / fad. whereas the highest profit (1090.3 LE) was recorded due to the addition of an optimum N level of 109.1 kg N/fad. followed by the profit obtained from Sids 9 (1074.2 LE) due to the addition of 105.6 kg N/fad.

INTRODUCTION

In Egypt, sustaining wheat production through maximizing unit land area productivity and increasing the cultivated area is the most important national target in order to minimize the gab between production and consumption. In the last few years, a number of long spike wheat cultivars was released but they did not fully express their high grain yield potentiality under sandy soil conditions. The present study was devoted with the hope of defining those factors which ceil the productivity of long spike wheat cultivars under these conditions. Though inherent factors within wheat spike play a great role on floral fertility (Evans *et al.*, 1972), there still a role is left to external factors in this respect (Milthorpe and Moorby, 1979).

A great variability in yield attributes and yield potentiality among Egyptian wheat cultivars was reported (Taha *et al.*, 1990 ; El Bana and Aly, 1993 ; El-Kalla *et al.*, 1994 ; Hassanein *et al.*, 1997 ; Aly, 1998 El-Karamity, 1998 ; Mahfouz and Ghabour, 1998 ; Abdel Gawad and Salem, 1999 ; Abdul Galil *et al.*, 2000 ; El-Hawary, 2000 and Hassan and Gaballah, 2000).

Historically, nitrogen has received much attention from researchers in wheat. Due to low N availability under sandy soil conditions. Several research workers got significant response to its fertilizers application. Abdel–Gawad *et al.*, (1994) and Selim (1998) reported that wheat responded to addition of 75 kg N/fad. whereas Metwally *et al.*, (1998) and Yakout *et al.*, (1998) found this response to 90 kg N/fad. Moreover, Abdul Galil *et al.*, (1997), Gomaa (1997), Attia and Aly (1998), Hegazi and Hassan (1998) and Hassan and Gaballah (2000) got this response up to 100 kg N/fad. Furthermore, many researchers got a significant response to more additions reaching 120 kg N/fad. as reported by Essia *et al.*, (1990), Abou-Salama *et al.*, (1995), Abd El-Hakem (1996), El-Nagar (1997), El-Bagoury *et al.*, (1998), El-Karamity (1998), Mahfouz and Ghabour (1998), Abdel-Gawad and Salem (1999) and El-Aggory *et al.*, (2001). A greater response to a higher N level of 160 kg N/fad. was reported by Fayed (1992) and Iskandar (2000). In all these responses, the significant increase of yield was attributed to the significant increase of its yield attributes.

Regarding floral fertility, and hence grain weight distribution along rachis and rachilla, Rawson and Ruwali (1972) and Bremner and Pinkerton (1974) indicated that the proximity of the different grains along rachilla affects their growth and their weight as evidenced by the order a > b > c > d > e. Saleh (1981) found that additions of N was effective to increase weight of grains in location (a) and (b). At low N level (30 kg N/fad.), florets in distal locations beyond (c) failed to set grains. Abdel-Gawad *et al.*, (1982) found cultivar differences in the anatomical structure of peduncle and hence their floral fertility. Moselhy (1995) found that splitting of N in five instead of two or three splits with the foliar application of the last one, increased floral fertility and hence the intra-spikelet competition. Moreover Abdul Galil *et al.*, (1997) observed that the increase in N level to 100 kg N/fad. increased the number of set grains where the favourable effect of N was more pronounced on grains (c) and (d) but grain (b) was still the heaviest. Recently, Abdul Galil *et al* (2000) got similar results in three wheat cultivars under sandy soil conditions, where the intra – spikelet competition was of more magnitude in the long spike wheat (Sids 4 and Sids 6) than in the short spike one (Gemmiza 3).

Therefore, the present study aimed to investigate the effect of nitrogen fertilization level on floral fertility, inter and intra spikelet competition and yield potentiality of four long spike wheat cultivars compared with two short spike ones when grown under sandy soil conditions.

MATERIALS AND METHODS

This investigation was conducted at the Agricultural Research Station of the Faculty of Agric., Zagazig University at Khattara for two growing seasons (1999/2000 and 2000/2001). The study aimed to investigate the effect of nitrogen fertilization levels on floral fertility, inter and intra spikelet competition and yield potentiality of four long spike wheat cultivars compared with two short spike ones when grown under sandy soil conditions. The soil of the experimental site is sandy in texture where it has a particle size distribution of 89.1, 6.6 and 4.3 % for sand, silt and clay, respectively. The soil had an average pH valve of 7.7 and organic matter content of 0.46 %. The available N, P and K contents were 10.1, 2.7 and 125 ppm, respectively (averaged over the two seasons for the upper 30 cm of soil depth).

Each experiment included two factors as follows :

A: wheat cultivars :

1- Sids 5 2- Sids 8

3-Sids 9 4- Sids 10

5- Gemmiza 7 6- Sakha 93

b: Nitrogen fertilizer levels :

1- 30 kg N/fad. 2- 60 kg N/fad.

3- 90 kg N/fad. 4-120 kg N/fad.

Phosphorus and potassium fertilizers were applied as basal dressing at sowing in the form of calcium super phosphate (15.5% $P_2 0_5$) and potassium sulphate (50% K_2o), respectively. Nitrogen was added in the form of ammonium sulphate (20.5%N) in six splits given at 10 days by interval at 20, 30, 40, 50, 60, and 70 days after sowing (DAS). Irrigation was practiced at 4 days intervals using sprinklers. The preceding crop was peanut in the two seasons.

A split plot design with three replications was followed where wheat cultivars were assigned to the main plots and N levels to the sub plots. Each plot ($13.5m^2$) included 20 rows, 15 cm apart. Seeds were hand drilled at rate of 80 kg/fad. on November 20th and 23rd in the two seasons, respectively. The other cultural practices for growing wheat under these conditions were applied.

At ear-emergence, flag leaf area of all plants taken from a 30 cm length of the third row was recorded according to Montgomery (1911). Chlorophyll content of these leaves was determined using chlorophyll meter (SPAD- 502, soil–plant analysis Development (SPAD) section Minolta Camera Co., Oska, Japan) according to Castelli *et al.*, (1996).

At harvest, five main spikes were randomly taken from guarded rows. Fertile spikelets were dissected from one side of each spike and were placed separately in small bags carrying their location numbers acropetally within each spikelet. The six basal grains were alphabetically designated from base according to their floret positions as a, b, c, d, e and f as shown in Fig. (1). No fertile florets were found beyond the 6th floret position. Individual grain weights were recorded for each grain positions within spikelet according to Lesch *et al.*, (1992).

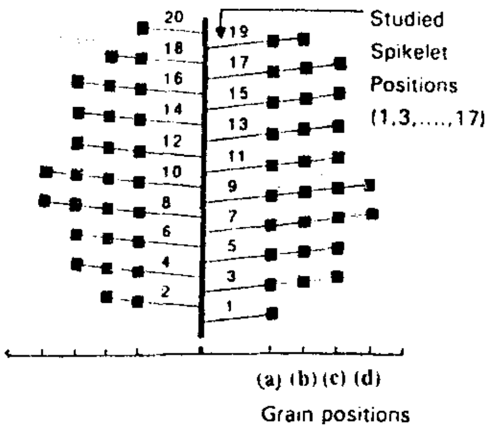

Fig. (1): Geometric representation of a spike, showing how fertile spikelet positions were scaled into spikelet locations and grain positions within spikelet.

From the abovementioned data, individual grain weight and number distributions along rachis, as well as, along rachilla were determined as follows :

a- Average single grain weight distribution along rachis :

The average grain weight (mg) per each studied spikelet position was recorded along spike axis through dividing the grain weight/spikelet by grain number of each spikelet position.

b- Average single grain weight distribution along rachilla :

The average grain weight (mg) of each grain position within spikelet was averaged over the nine studied spikelet positions.

c- Inter–Intra spikelet competition index (IISCI) :

Though variations among individual grain weights along rachis, as well as, along rachilla follow a geometrical pattern according to their floral position, however, Moselhy (1995) found that agronomic practices played a role in these variations. According to him variation among individual grain weights along rachis or along rachilla could be served to express the magnitude of inter and intra spikelet competition, respectively.

The IISCI was calculated according to him with the help of the following equation :

$$IISCI = \frac{\text{C.V. of individual grain weight average along rachis.}}{\text{C.V. of individual grain weight average along rachilla.}}$$

At harvest, also, plant samples were taken from an area of 0.5 m^2 to determine plant height, spike length, number of fertile spikelets and grains/spike, 1000–grain weight and grain weight/spike. Grain and straw yields (ton/fad.) were determined from a central area of 3.0 m^2 (ten rows by 2 meter long).

Analysis of variance and combined analysis for the two seasons were carried out as described by Snedecor and Cochran (1967). For comparison between means, Duncan's new multiple range test was applied Duncan, (1955).

The response equations were calculated according to Snedecor and Cochran (1967) using the orthogonal polynomial Tables. The significancy of the linear and quadratic components of each of these equations were tested and hence the response could be described as linear (1st degree) or quadratic (2nd degree).

The expected maximum grain yield (Y max.) and the expected optimum grain yield (Y opt.) were calculated using the expected maximum (X max.) and optimum (X opt.) N levels, in respective order. Also, the total profit gained due to the addition of the optimum N level was calculated with the help of the following equations according to Sukhatme (1941).

$$\hat{Y}max. = Y_0 + \frac{b^2}{4c}$$

$$\hat{Y}\ opt. = Y_0 + b\ x\ opt. - c\ x\ opt.$$

$$X\ max. = \frac{b}{2c} + x_0$$

$$X\ opt. = \frac{b-r}{2c} + x_0$$

Total Profit = profit (1)+profit (2)

Where :

Profit (1) = P [Y_0] - Q

Profit (2) = P [C (X opt.)^2]

Y_0 = Grain yield at the lowest N level i.e. 30 kg N/fad.

b = Measures the linear component in the response equation.

c = Measures the quadratic component in the response equation.

r = Q/P where Q = Cost of a N unit i.e. 30 kg N/fad. = 60 LE.

P = Price of a unit grain yield (ton) = 666 LE.

According the total profit (Pr_t) was calculated through summation of profit (1) + profit (2). It is worth to note down here that in calculation of these profits, the other spent costs for the other agronomic practices or any other related expenses were not taken in consideration as it was not under the interest of this study. However, the total profit obtained through the aforementioned calculations still gives an enough indication to the expected gain from addition of nitrogen fertilizer. This profit was also calculated for each wheat cultivar under study and hence both gains satisfy the interest of the present study, keeping in mind that all the other costs and expenses were the same for the six wheat cultivars under study.

RESULTS AND DISCUSSION

A. Yield and yield attributes:

A.1. Cultivar differences :

Results in Table (1) exhibit significant differences among the tested wheat cultivars, regarding flag leaf area and its chlorophyll content where Sids 9 followed by

Table (1) : Yield and yield attributes of the tested wheat cultivars as affected by nitrogen levels in the two seasons and their combined.

Main effects and interactions	Flag leaf area (cm^2)			◆Flag leaf chlorophyll content			Plant height (cm)			Number of spikes / m^2		
	99/2000	2000/2001	combined	99/2000	2000/2001	combined	99/2000	2000/2001	combined	99/2000	2000/2001	combined
Cultivars (V):												
Sids 5	23.34 b	25.58 bc	24.46 bc	39.18 b	41.68 b	40.43 b	84.25 d	87.71 b	85.98 c	282.0 c	293.3 c	287.6 c
Sids 8	23.14 b	25.23 cd	24.18 bc	39.26 b	41.64 b	40.45 b	83.89 d	87.52 bc	85.71 c	282.3 c	292.7 c	287.5 c
Sids 9	25.87 a	27.79 a	26.83 a	41.88 a	42.60 a	42.24 a	85.71 b	87.80 b	86.76 b	289.2 b	301.2 b	295.2 b
Sids 10	23.42 b	25.52 bcd	24.47 b	39.58 b	41.59 b	40.59 b	84.33 d	87.33 bc	85.83 c	283.0 c	294.1 c	288.6 c
Gemmiza 7	23.10 b	25.20 d	24.15 c	37.47 c	40.62 c	39.05 c	88.29 a	91.16 a	89.72 a	312.0 a	319.9 a	316.0 a
Sakha 93	23.18 b	25.72 b	24.45 bc	37.51 c	39.87 d	38.69 d	84.99 c	86.75 c	85.87 c	311.2 a	320.7 a	316.0 a
F. test	**	**	**	**	**	**	**	**	**	**	**	**
Nitrogen levels (N):												
30 kg N/fad.	22.00 c	23.99 c	22.99 c	37.65 c	39.88 c	38.76 c	82.76 c	85.31 c	84.04 c	282.7 d	292.7 c	287.7 d
60 kg N/fad.	22.74 b	25.13 b	23.94 b	38.52 b	40.79 b	39.65 b	84.32 b	87.14 b	85.73 b	289.5 c	300.8 b	295.1 c
90 kg N/fad.	24.87 a	27.08 a	25.98 a	39.90 a	42.19 a	41.05 a	86.82 a	89.66 a	88.24 a	298.5 b	310.1 a	304.3 b
120 kg N/fad.	25.09 a	27.15 a	26.12 a	40.52 a	42.48 a	41.50 a	87.07 a	90.06 a	88.57 a	302.4 a	310.9 a	306.7 a
F. test	**	**	**	**	**	**	**	**	**	**	**	**
Interactions:												
VXN	NS	NS	NS	NS	*	NS	**	*	**	NS	NS	NS

◆ Determined using chlorophyll meter (SPAD).

*, ** and N.S indicate significant at 0.05, 0.01 and insignificant, respectively.

Cont. Table (1) .

Main effects and interactions	Spike length (cm)			Number of fertile spikelet/spike			Number of grains / spike			Thousand grain weight (gm)		
	99/2000	2000/2001	combined	99/2000	2000/2001	combined	99/2000	2000/2001	combined	99/2000	2000/2001	combined
Cultivars (V):												
Sids 5	10.48 b	10.93 b	10.71 b	17.11 a	18.27 ab	17.69 b	45.09 b	47.35 ab	46.22 b	47.62 a	49.78 a	48.70 a
Sids 8	10.43 b	10.99 b	10.71 b	17.27 a	17.93 c	17.60 b	45.06 b	43.88 bc	44.47 b	47.70 a	49.81 a	48.75 a
Sids 9	11.17 a	11.71 a	11.44 a	17.46 a	18.56 a	18.01 a	47.56 a	50.31 a	48.93 a	46.48 b	47.72 b	47.10 b
Sids 10	10.45 b	10.95 b	10.70 b	17.25 a	18.03 bc	17.64 b	45.23 b	47.83 ab	46.53 b	46.48 b	47.72 b	47.10 b
Gemmiza 7	9.415 c	9.531 c	9.473 c	15.70 c	17.05 d	16.38 c	37.44 c	39.12 c	38.28 c	42.21 c	42.90 c	42.56 c
Sakha 93	9.438 c	9.515 c	9.476 c	16.18 b	16.96 d	16.57 c	37.02 c	38.99 c	38.00 c	39.43 d	41.28 d	40.36 d
F. test	**	**	**	**	**	**	**	**	**	**	**	**
Nitrogen levels (N):												
30 kg N/fad.	9.434 c	9.755 c	9.594 c	16.15 c	16.71 d	16.43 d	38.56 c	40.05 b	39.30 c	43.34 c	44.73 c	44.03 c
60 kg N/fad.	9.903 b	10.33 b	10.12 b	16.49 b	17.38 c	16.93 c	41.95 b	45.07 a	43.51 b	44.30 b	45.93 b	45.12 b
90 kg N/fad.	10.80 a	11.15 a	10.97 a	17.38 a	18.35 b	17.86 b	45.56 a	47.85 a	46.71 a	46.12 a	47.68 a	46.90 a
120 kg N/fad.	10.78 a	11.19 a	10.99 a	17.30 a	18.77 a	18.04 a	45.54 a	45.35 a	45.45 a	46.19 a	47.79 a	46.99 a
F. test	**	**	**	**	**	**	**	**	**	**	**	**
Interactions:												
VXN	**	NS	NS	*	NS	NS	**	NS	NS	**	*	**

*, ** and N.S indicate significant at 0.05, 0.01 and insignificant, respectively.

Cont. Table (1) .

Main effects and interactions	Grain weight / spike (gm)			Grain yield / fad. (ton)			Straw yield / fad. (ton)		
	99/2000	2000/2001	combined	99/2000	2000/2001	combined	99/2000	2000/2001	combined
Cultivars (V):									
Sids 5	1.897 b	2.002 b	1.950 b	1.469 c	1.591 b	1.530 c	2.833 b	2.984 c	2.909 cd
Sids 8	1.891 b	2.020 a	1.955 b	1.496 b	1.595 b	1.545 b	2.828 b	2.937 d	2.882 d
Sids 9	1.985 a	2.025 a	2.005 a	1.615 a	1.731 a	1.673 a	2.911 ab	3.040 b	2.976 b
Sids 10	1.907 b	1.971 c	1.939 b	1.487 b	1.580 b	1.534 c	2.895 b	2.984 c	2.939 bc
Gemmiza 7	1.550 d	1.650 d	1.600 d	1.355 d	1.374 c	1.364 e	2.913 ab	3.074 a	2.994 ab
Sakha 93	1.586 c	1.658 d	1.622 c	1.361 d	1.389 c	1.375 d	3.024 a	3.065 ab	3.045 a
F. test	**	**	**	**	**	**	*	**	**
Nitrogen levels (N):									
30 kg N/fad.	1.744 c	1.806 d	1.775 d	1.118 d	1.200 c	1.159 d	2.738 c	2.828 d	2.783 d
60 kg N/fad.	1.789 b	1.841 c	1.815 c	1.372 c	1.434 b	1.403 c	2.822 c	2.925 c	2.873 c
90 kg N/fad.	1.834 a	1.938 b	1.886 b	1.668 b	1.767 a	1.718 b	2.916 b	3.079 b	2.997 b
120 kg N/fad.	1.844 a	1.966 a	1.905 a	1.697 a	1.772 a	1.734 a	3.128 a	3.224 a	3.176 a
F. test	**	**	**	**	**	**	**	**	**
Interactions:									
VXN	*	NS	**	**	**	**	NS	**	NS

*, ** and N.S indicate significant at 0.05, 0.01 and insignificant, respectively.

Sids 10, Sids 8 and Sids 5 had higher averages than Gemmiza 7 and Sakha 93. Regarding plant height, Gemmiza 7 followed by Sids 9 had the tallest plants among the tested cultivars. It is evident also, that Gemmiza 7 and Sakha 93 produced the highest number of spikes/m^2 followed in descending order by Sids 9 and then by Sids 10, Sids 5 and Sids 8. However, all the Sids group were superior in spike length, number of fertile spikelets/spike, number of grains/spike and 1000–grain weight, as well as, in grains weight/spike. Within this group Sids 9 gave significantly longer spikes with more number of fertile spikelets and hence grains/spike than the other Sids cultivars, but, Sids 5 and Sids 8 had heavier 1000 – grain weight. It is quite evident from Table (1) that Sids cultivars outyielded Sakha 93 and Gemmiza 7 in grain yield. Among the formers, Sids 9 secured the highest yield followed in descending order by Sids 8, Sids 10 and Sids 5. The lowest grain yield was recorded by Gemmiza 7. These results could be explained by the better spike characteristics of Sids 9 and the other Sids group cvs compared with Gemmiza 7 and Sakha 93 and hence compensated the decrements in the number of spikes/m^2 of this group. It is worth to mention that Sids 9 had the highest flag leaf area with the highest chlorophyll content (Table 1). The contribution of flag leaf as a main source of grain yield cannot be denied or neglected. The larger sink, as expressed in greater number of spikelets and grains/ spike, could also made great contribution to the high grain yield potentiality of Sids 9.

Regarding straw yield/fad., Sakha 93 and Gemmiza 7 recorded the highest straw yields/fad. compared with the other cultivars. In this respect, cultivars could be. arranged in descending order as follows. Sakha 93, Gemmiza 7, Sids 9, Sids 10, Sids 5 and Sids 8. The superiority of Sakha 93 and Gemmiza 7 in straw yield/fad. could be attributed to their taller plants with larger number of spikes/m^2 as compared with the Sids group cvs. The differences in yield and its attributes among the studied wheat cultivars might be attributed to their genetic constitution as reported by Aly (1998), El-Karamity (1998), Mahfouz and Ghabour (1998), Abdel-Gawad and Salem (1999), Abdul-Galil *et al.*, (2000), El-Hawary (2000) and Hassan and Gaballah (2000).

A.2. Nitrogen level effect :

Data in Table (1) show that the application of N up to 90 kg N/fad. significantly increased flag leaf area and its chlorophyll content, plant height, spike length, No. of grains/spike and 1000- grain weight. However, the number of spikes/m^2, number of fertile spikelets/spike and grain weight/spike were significantly increased due to the increase of N level up to 120 kg N/fad. as indicated from the combined analysis. The increase in plant height may be attributed to internode elongation caused by the addition of N (Peltonen *et al.*, 1995).

Grain and straw yields responded significantly to increasing N level from 30 to 120 kg N/fad. where each increment of 30 kg N produced a significant increase. Regarding grain yield/fad. and according to the combined analysis, the first N increment produced a significant increase of 21.05%, the second N increment gave an increase of 22.45% whereas the third N increment achieved an increase of 0.93 % only. The increase in grain yield caused by the increase of N level may be attributed to the role of N in increasing yield components. These results are in harmony with those of others (Abdel-Hakem, 1996 ; El-Nagar, 1997 ; El-Bagoury *et al.*, 1998 ; El–Karamity, 1998 ; Mahfouz and Ghabour, 1998 ; Abdel–Gawad and Salem, 1999 and El–Aggory *et al.*, 2001).

A.3. Interaction effect :

Significant varietal response to N level was detected in each of 1000- grain weight (Table 1-a), grain weight/spike (Table 1-b) and grain yield/fad. (Table 1-c).

In all these interactions, the increase of N levels produced a significant increase up to addition of 90 kg N/fad. as the last N increment was without significant effect. However, the response of grain yield/fad., clearly indicate that Sids 5, Sids 8 and Sids 9 produced more than 100 kg grain/fad. due to each N increment whereas Sids 10, Gemmiza 7 and Sakha 93 showed lower response. According to these data, N fertilization was more effective on Sids group than in Gemmiza 7 and Sakha 93. This cultivar response could be attributed to differences of spike length, as well as, grain number and fertile spikelets/spike (Table 1).

A.4. Response analysis and profit:

Data in Table (2) show the response of the six wheat cultivars to N fertilization and the expected maximum grain yield which could be obtained at the maximum N level to which a significant response could be obtained. The Table is provided also by the optimum N level which could produce the optimum grain yield as well as the profit gained from the addition of the lowest N level under study (30 kg N/fad.), as well as, the profit gained from the increase of N level over 30 kg N/fad. to the optimum N level and the total profit from N fertilization

Table (1-a) : The Interaction effect between N levels and cultivars on 1000-grain weight of wheat (combined).

	Sids 5	Sids 8	Sids 9	Sids 10	Gemmiza 7	Sakha 93
30 kg N/fad.	A 46.593 c	A 46.750 c	B 45.630 c	B 45.627 c	C 40.487 c	D 39.105 c
60 kg N/fad.	A 47.658 b	A 47.687 b	B 46.602 b	B 46.615 b	C 42.005 b	D 40.127 b
90 kg N/fad.	A 50.253 a	A 50.228 a	B 48.035 a	B 48.035 a	C 43.748 a	D 41.110 a
120 kg N/fad.	A 50.283 a	A 50.345 a	B 48.120 a	B 48.127 a	C 43.980 a	D 41.078 a
Regression coefficient	0.683	0.670	0.45	0.45	0.61	0.34

Table (1-b) : The Interaction effect between N levels and cultivars on grain weight/spike (combined).

	Sids 5	Sids 8	Sids 9	Sids 10	Gemmiza 7	Sakha 93
30 kg N/fad.	A 1.880 d	A 1.912 b	A 1.887 c	A 1.877 d	B 1.542 b	B 1.555 c
60 kg N/fad.	AB 1.930 c	B 1.910 b	A 1.955 b	AB 1.920 c	D 1.563 b	C 1.610 b
90 kg N/fad.	BC 1.975 b	B 2.002 a	A 2.073 a	C 1.957 b	D 1.648 a	D 1.660 a
120 kg N/fad.	B 2.013 a	B 1.998 a	A 2.105 a	B 2.003 a	C 1.647 a	C 1.663 a
Regression coefficient	0.022	0.018	0.039	0.021	0.020	0.019

Table (1-c) : The Interaction effect between N levels and cultivars on grain yield/fad. of wheat (combined).

	Sids 5	Sids 8	Sids 9	Sids 10	Gemmiza 7	Sakha 93
30 kg N/fad.	C 1.158 c	C 1.158 c	A 1.265 c	B 1.225 c	D 1.067 c	D 1.082 c
60 kg N/fad.	B 1.402 b	B 1.421 b	A 1.561 b	B 1.403 b	C 1.299 b	C 1.330 b
90 kg N/fad.	BC 1.773 a	B 1.790 a	A 1.929 a	C 1.739 a	D 1.537 a	D 1.538 a
120 kg N/fad.	BC 1.787 a	B 1.812 a	A 1.935 a	C 1.768 a	D 1.554 a	D 1.550 a
Regression coefficient	0.113	0.117	0.119	0.098	0.085	0.081

Table (2) : Response equations, expected maximum yield, maximum and optimum N levels and profit gained from nitrogen fertilization for the six wheat cultivars (combined of the two seasons).

Cultivars	Response equations	Y max. (ton/fad)	X max. (kg N/fad)	X optimum (kg N/fad)	*Profit (1) (LE)	**Profit (2) (LE)	***Total profit (LE)
Sids 5	$1.312 + 0.405\ X - 0.060\ X^2$	1.998	131.6	109.1	813.8	276.5	1090.3
Sids 8	$1.135 + 0.413\ X - 0.060\ X^2$	1.846	130.5	110.7	695.9	289.7	985.6
Sids 9	$1.243 + 0.455\ X - 0.073\ X^2$	1.958	124.2	105.6	767.8	306.4	1074.2
Sids 10	$1.201 + 0.308\ X - 0.037\ X^2$	1.838	154.0	117.8	739.9	212.9	952.8
Gemmiza 7	$1.049 + 0.304\ X - 0.044\ X^2$	1.312	134.0	103.3	638.6	173.3	811.7
Sakha 93	$1.199 + 0.390\ X - 0.072\ X^2$	1.918	111.8	92.9	738.5	209.2	947.7

*** Profit (1) = Profit obtained with the addition of 30 kg N/fad. = $PY_0 - Q$**

**** Profit (2) = Profit obtained when N level was increased from 30 kg N/fad. to the optimum N level = $P[C(X\ opt.)^2]$.**

***** Total profit = Total profit obtained due to addition of optimum N level = profit (1) + profit (2)**

(P) Price /ton = 666 LE **(Q) Cost of N unit = 60 LE.**

Costs of the other agricultural practices should be deducted to obtain the net profit, which is not under investigation. To obtain the net profit, costs of the other agricultural practices other than N fertilization should be deducted.

A.4-a Cultivar response at the lowest N level :

It is quite evident from the table that the six cultivars under study varied greatly regarding their grain yield potentiality when fertilized with the lowest N level where Sids 5 secured the highest grain yield (1.312 ton/fad.) followed by Sids 9 and Sids 10 (1.243 and 1.201 ton/fad.), respectively whereas the lowest yield of Sids group was obtained from Sids 8 (1.135 ton/fad.). Regarding the rest two wheat cultivars, Sakha 93 produced higher grain yield (1.199 ton/fad.) than Gemmiza 7 (1.049 ton/fad.) which recorded the lowest yield among all the tested cultivars.

A.4-b Cultivars response to the increase of N level :

It is evident that the, the six cultivars under study showed differential response to the increase of N level over 30 kg N/fad. Different yield maximum could have been obtained due to the addition of different N level where the expected maximum could be recorded for Sids 5 (1.998 ton/fad.) followed by Sids 9 (1.958 ton/fad.) when 131.6 and 124.2 kg N/fad. were added, respectively.

It is quite interesting to note down here that Sakha 93 which produced lower grain yield than Sids 10 at the lowest N level, could record higher grain yield of 1.918 ton/fad. due to the addition of lower N level (111.8 kg N/fad.) compared with a maximum of 1.838 ton/fad. which could be obtained if the level was increased over the highest N level i.e. when 154 kg N/fad. could have been added, to Sids 10.

From the response point of view, all cultivars, under study except Sakha 93 were in need for more N than the highest N level tried in this study where Sids 10 was in need of 154 kg N/fad. though it produced lower grain yield (1.838 ton/fad.) than that recorded by Sids 9 (1.958 ton/fad.) but with only 124.2 kg N/fad. Also the lowest response to N increase was observed from Sakha 93 where it responded to only 111.8 kg N/fad. but produced a grain yield (1.92 ton/fad.) which was almost at par with that recorded by either Sids 5 (1.998 ton/fad.) or Sids 9 (1.958 ton/fad.)

A.4-c Profit gained from N fertilization:

Regarding the total profit obtained due to N fertilization. The highest profit (1090.3 LE) could be obtained due to the addition of 109.1 kg N/fad. to Sids 5 followed by the profit obtained from Sids 9 (1074.2 LE) due to the addition of 105.6 kg N/fad. The lowest profit (811.7 LE) was recorded for Gemmiza 7 due to the addition of 103.3 kg N/fad.

B. Average single grain weight distribution along rachis.

B.1- Cultivar differences :

In the two seasons and their combined, Sids 5 and Sids 8 had

Table (3) : Average single grain weight distribution along rachis as affected by cultivars and nitrogen levels in the two seasons and their combined.

Main effects and interactions	1999/2000								
	Spikelet position number from spike base								
	1	3	5	7	9	11	13	15	17
Cultivars (V):	--------- mg ---------								
Sids 5	42.96 a	44.78 a	47.10 a	49.32 a	50.47 a	51.42 a	50.17 a	44.36 c	42.52 a
Sids 8	42.96 a	44.48 a	47.29 a	49.42 a	50.57 a	51.34 ab	50.46 a	44.86 b	42.51 a
Sids 9	41.41 bc	44.37 a	46. 51 a	48.05 b	49.59 b	50.20 c	49.31 b	43.85 d	41.83 bc
Sids 10	41.93 b	44.02 a	46.72 a	47.83 b	49.57 b	50.55 bc	49.59 b	43.67 d	41.92 b
Gemmiza 7	38.50 d	40.94 c	45.68 b	47.21 b	49.47 b	50.70 abc	47.39 c	42.55 e	41.47 c
Sakha 93	40.80 c	42.98 b	44.79 c	47.16 b	49.35 b	50.75 abc	49.73 b	46.08 a	42.63 a
F. test	**	**	**	**	**	*	**	**	**
Nitrogen levels (N):									
30 kg N/fad.	38.84 c	41.28 c	43.22 c	44.84 c	47.38 c	48.39 c	47.02 d	41.47 c	38.92 c
60 kg N/fad.	40.91 b	42.83 b	45.61 b	47.92 b	48.93 b	50.20 b	48.98 c	43.83 b	42.25 b
90 kg N/fad.	42.93 a	45.04 a	48.20 a	49.93 a	51.47 a	52.36 a	50.69 b	45.73 a	43.60 a
120 kg N/fad.	43.04 a	45.23 a	48.37 a	49.95 a	51.56 a	52.36 a	51.07 a	45.88 a	43.81 a
F. test	**	**	**	**	**	**	**	**	**
	▲0.73	0.70	0.90	0.87	0.75	0.70	0.69	0.76	0.80
Interactions:									
VXN	NS	NS	*	*	NS	NS	NS	NS	**

▲ Regression coefficient.

Cont. Table (3).

Main effects and interactions	2000/2001								
	Spikelet position number from spike base								
	1	3	5	7	9	11	13	15	17
Cultivars (V):	--------- mg ---------								
Sids 5	40.92 a	43.28 b	45.11 a	46.97 a	48.14 a	49.95 a	51.33 b	43.62 a	39.56 a
Sids 8	41.15 a	42.78 b	45.16 a	46.82 ab	47.93 a	49.92 a	51.86 a	43.25 ab	39.51 a
Sids 9	41.26 a	42.50 b	44.06 b	46.04 bc	47.54 ab	49.21 b	49.86 c	42.62 b	38.89 ab
Sids 10	39.54 b	44.28 a	44.42 b	45.86 c	47.26 b	49.25 b	49.78 c	42.61 b	38.08 b
Gemmiza 7	37.84 c	40.03 d	42.58 c	45.14 cd	45.62 c	48.33 c	48.34 d	40.46 c	38.80 ab
Sakha 93	38.41 c	40.99 c	40.61 d	44.55 d	45.27 c	48.18 c	48.63 d	40.36 c	34.05 c
F. test	**	**	**	**	**	**	**	**	**
Nitrogen levels (N):									
30 kg N/fad.	36.91 c	39.65 c	41.22 c	43.13 c	44.84 c	47.10 d	47.51 c	39.64 c	35.98 c
60 kg N/fad.	39.38 b	42.05 b	43.43 b	45.14 b	46.22 b	48.15 c	49.27 b	42.27 b	37.44 b
90 kg N/fad.	41.36 a	43.48 a	44.91 a	47.55 a	48.16 a	50.10 b	51.58 a	43.37 a	39.58 a
120 kg N/fad.	41.77 a	44.05 a	45.06 a	47.77 a	48.62 a	51.21 a	51.51 a	43.33 a	39.59 a
F. test	**	**	**	**	**	**	**	**	**
	▲ 0.83	0.73	0.65	0.82	0.66	0.71	0.72	0.61	0.65
Interactions:									
VXN	*	NS	*	NS	*	NS	NS	NS	NS

▲ Regression coefficient.

Cont. Table (3).

Main effects and interactions	Combined								
	Spikelet position number from spike base								
	1	3	5	7	9	11	13	15	17
Cultivars (V):					---------- mg ----------				
Sids 5	41.94 a	44.03 ab	46.11 a	48.14 a	49.30 a	50.68 a	50.75 b	43.99 a	41.04 a
Sids 8	42.06 a	43.63 ab	46.23 a	48.12 a	49.25 a	50.63 a	51.16 a	44.05 a	41.01 a
Sids 9	41.34 b	43.44 b	45.28 b	47.05 b	48.57 b	49.71 b	49.59 c	43.24 b	40.36 b
Sids 10	40.74 c	44.15 a	45.57 b	46.84 b	48.41 b	49.90 b	49.69 c	43.14 b	40.00 b
Gemmiza 7	38.17 e	40.49 d	44.13 c	46.18 c	47.54 c	49.52 b	47.87 e	41.50 c	40.14 b
Sakha 93	39.60 d	41.98 c	42.70 d	45.86 c	47.31 c	49.47 b	49.18 d	43.22 b	39.34 c
F. test	**	**	**	**	**	**	**	**	**
Nitrogen levels (N):									
30 kg N/fad.	37.88 c	40.47 c	42.22 c	44.00 c	46.11 c	47.74 d	47.27 c	40.55 c	37.45 c
60 kg N/fad.	40.14 b	42.44 b	44.52 b	46.53 b	47.58 b	49.18 c	49.13 b	43.05 b	39.85 b
90 kg N/fad.	42.14 a	44.26 a	46.55 a	48.74 a	49.81 a	51.23 b	51.14 a	44.55 a	41.59 a
120 kg N/fad.	42.40 a	44.64 a	46.72 a	48.86 a	50.09 a	51.79 a	51.29 a	44.61 a	41.70 a
F. test	**	**	**	**	**	**	**	**	**
	▲ 0.78	0.72	0.78	0.84	0.71	0.71	0.70	0.68	0.72
Interactions:									
VXN	*	NS	**	**	*	NS	NS	NS	NS

▲ Regression coefficient.

heavier average single grain weight along rachis than the others cvs. Also Sids 9 and Sids 10 had heavier average single grain weight than Gemmiza 7 and Sakha 93. This was true at almost all spikelet positions with highly significant differences (Table 3).

The superiority of Sids 5 and Sids 8 in average single grain weight could account for their higher 1000-grain weights compared with the other cvs. (Table 1). These data are in harmony with those reported by Moselhy (1995) and Abdul Galil *et al.*, (1997) and (2000).

B.2. Nitrogen level effect :

The increase in N level from 30 to 60 and then 90 or 120 kg N/fad. was effective to increase the average single grain weight at all spikelet positions along the spike axis. This was valid in the two seasons and their combined. As indicated from the regression coefficients, the response of the average single grain weight to the increase of N level was almost the same at all spikelet positions along rachis.

B.3. Interaction effect :

Some of the interactions affected significantly the average single grain weight at some spikelet positions as indicated from Table (3). No separate tables are devoted for these interactions because most of them did not added more information than the main effects.

C. Average single grain weight distribution along rachilla.

C.1 Cultivar differences :

Sids 5 and Sids 8 cvs recorded the heaviest average single grain weight along rachilla in location a, b, c, and d whereas Gemmiza 7 and Sakha 93 recorded the lightest averages with Sids 9 and Sids 10 in between.

Regarding locations e and f, it is worth to note that Gemmiza 7 and Sakha 93 failed to carry grains in these locations. This was true in the two seasons and their combined. In the six wheat cvs, grains in location b were heavier than in location a followed by grains c and d as well as e and f (if present) in descending order (Table 4).

These data are quite interesting as they clearly indicate that the four Sids cvs carried more number of grains/spikelet than Gemmiza 7 and Sakha 93 and further indicate that grains of Sids 5 and Sids 8 cvs were afforded better intra-spiklete competition than those of Sids 9 and Sids 10 cvs as they had heavier average single grain weight at all these locations (Table 3).

Under optimum growing conditions, Milthorpe and Moorby (1979) indicated that grain weights within spikelet should follow the order c = b > a > d > e. They added that under less optimum condition, grain weights followed the order b >

Table (4) : Average single grain weight distribution along rachilla as affected by cultivars and nitrogen levels in the two seasons and their combined.

Main effects and interactions	1999/2000						2000/2001					
	a	b	c	d	e	f	a	b	c	d	e	f
Cultivars (V):						------ mg ------						
Sids 5	53.48 a	55.50 a	53.33 a	46.75 b	34.20 a	25.14	52.13 a	53.66 a	51.82 a	45.21 a	30.76 ab	22.75 c
Sids 8	53.56 a	55.37 a	53.36 a	47.61 a	34.35 a	25.56	52.51 a	53.76 a	52.35 a	44.99 a	31.04 a	23.26 b
Sids 9	51.01 b	53.49 b	51.06 b	44.80 c	33.12 b	25.11	49.19 b	52.74 b	50.21 b	44.20 ab	29.80 bc	22.56 c
Sids 10	51.26 b	53.51 b	51.47 b	44.81 c	32.90 b	25.18	49.22 b	52.90 b	50.32 b	43.26 bc	29.67 c	24.57 a
Gemmiza 7	50.86 b	53.04 bc	49.28 c	44.39 c	-	-	48.91 b	50.83 c	48.06 c	42.64 c	-	-
Sakha 93	49.22 c	52.04 c	49.49 c	43.39 d	-	-	47.71 c	50.02 d	48.07 c	40.99 d	-	-
F. test	**	**	**	**	**	NS	**	**	**	**	**	**
Nitrogen levels (N):												
30 kg N/fad.	48.42 c	51.42 c	48.74 c	42.11 c	20.52 c	14.96 c	47.10 c	49.45 c	46.85 c	40.42 c	18.07 b	13.54 c
60 kg N/fad.	51.08 b	53.36 b	50.74 b	44.81 b	22.05 b	16.60 b	49.35 b	52.33 b	49.68 b	43.29 b	20.75 a	14.83 b
90 kg N/fad.	53.32 a	55.25 a	52.95 a	47.13 a	23.58 a	17.88 a	51.67 a	53.68 a	52.01 a	45.22 a	21.20 a	16.85 a
120 kg N/fad.	53.44 a	55.26 a	52.91 a	47.12 a	23.58 a	17.88 a	51.66 a	53.81 a	52.01 a	45.26 a	21.26 a	16.86 a
F. test	**	**	**	**	**	**	**	**	**	**	**	**
	▲ 0.87	0.67	0.74	0.87	0.54	0.52	0.80	0.72	0.89	0.82	0.50	0.60
Interactions:												
VXN	**	NS	**	NS	**	**	NS	NS	NS	*	*	**

▲ Regression coefficient.

Cont. Table (4).

Main effects and interactions	Combined					
	a	b	c	d	e	f
Cultivars (V):			------ mg ------			
Sids 5	52.81 a	54.58 a	52.57 a	45.98 a	32.48 a	23.95 c
Sids 8	53.03 a	54.57 a	52.86 a	46.30 a	32.70 a	24.41 b
Sids 9	50.10 b	53.11 b	50.63 b	44.50 b	31.46 b	23.83 c
Sids 10	50.24 b	53.20 b	50.90 b	44.04 bc	31.29 b	24.88 a
Gemmiza 7	49.89 b	51.94 c	48.67 c	43.52 c	-	-
Sakha 93	48.47 c	51.03 d	48.78 c	42.19 d	-	-
F. test	**	**	**	**	**	**
Nitrogen levels (N):						
30 kg N/fad.	47.76 c	50.43 c	47.79 c	41.26 c	19.30 c	14.25 c
60 kg N/fad.	50.22 b	52.85 b	50.21 b	44.05 b	21.40 b	15.72 b
90 kg N/fad.	52.50 a	54.47 a	52.48 a	46.18 a	22.39 a	17.36 a
120 kg N/fad.	52.55 a	54.54 a	52.46 a	46.19 a	22.42 a	17.38 a
F. test	**	**	**	**	**	**
	▲ 0.83	0.70	0.81	0.85	0.52	0.55
Interactions:						
VXN	NS	NS	**	*	**	**

▲ Regression coefficient.

a > c > d > e as obtained herein. Under severe growing conditions, grain in location a is the heaviest followed by grains b, c, d and e in descending order. However, several workers found that grain in location b was always heavier than those in location c or a and in turn those in location d, e and f due to internal factors (Moselhy, 1995, Abdul-Galil *et al*, 1997 and Abdul-Galil *et al* 2000). This was explained by Abdel-Gawad *et al* (1982) due to a well developed vascular system serving grain in floret b. However, Brocklehurst (1977) attributed this superiority to a larger number of endosperm cells in grain b.

C.2. Nitrogen level effect :

A very clear trend was observed in the two seasons and their combined that the increase of N level up to 90 or 120 kg N/fad. increased the average single grain weight in all grain locations within spikelet. It is evident also that grains in locations a, b, c, and d showed greater response than those in distal locations along rachilla (e and f) to N level (Table 4).

According to the combined analysis, the response of grain (e) and (f) to the increase of N level was only 0.52 and 0.55 mg/N unit compared with 0.83, 0.70, 0.81 and 0.85 mg for grains a, b, c and d, respectively.

These data clearly show that the increase of N level was in favour of the latters than in the formers indicating that lower grains along rachilla had higher competitive capacity than the next higher ones for assimilate accumulation these data are in accordance with those reported by Rawson and Evans(1970).

C.3. Interaction effect :

According to the combined analysis there was varietal response to N levels on grains c, d, e and f within spikelet. These interactions are given in Table (4-a) for these grains and provided with regression coefficients to express the magnitude of cultivar response of each grain location to N levels.

The most interesting of the results presented in (Table 4-a) are those of grain (e) and (f) which were set for the four Sids cultivars only as mentioned before. The response of grains in these two locations and in particular in the most distal location (f) to the increase of N level could explain the superiority of Sids 5 and Sids 8 in 1000- grain weight (Table 1).

It is quite evident that the response of grain (f) to the increase of N level was much higher for Sids 5 (0.98 mg) and Sids 8 (0.85 mg) than in Sids 9 (0.73 mg) or Sids 10 (0.75 mg).

According to this differential response, the increase of N level was generally in favour of grain a, b, c and d for all cultivar but was in favour of grain (f) for Sids 5 and Sids 8.

Table (4-a) : Average single grain weight (mg) for grain locations from c to f within spikelet as affected by cultivars X N levels interaction (combined).

	Sids 5	Sids 8	Sids 9	Sids 10	Gemmiza 7	Sakha 93
grain c						
30 kg N/fad.	A 49.793 c	A 50.275 c	B 47.502 c	B 47.858 c	D 45.173 c	C 46.160 c
60 kg N/fad.	A 51.768 b	A 51.858 b	C 50.150 b	B 50.845 b	D 48.058 b	D 48.562 b
90 kg N/fad.	A 54.355 a	A 54.673 a	B 52.438 a	B 52.538 a	C 50.650 a	C 50.210 a
120 kg N/fad.	A 54.370 a	A 54.618 a	B 52.447 a	B 52.353 a	C 50.793 a	C 50.185 a
Regression coefficient	0.82	0.79	0.86	0.76	0.97	0.69
grain d						
30 kg N/fad.	A 43.170 c	A 43.023 c	B 40.922 c	B 40.613 c	B 40.712 c	C 39.147 c
60 kg N/fad.	A 45.677 b	A 46.305 b	B 44.170 b	C 43.167 b	C 43.152 b	D 41.822 b
90 kg N/fad.	A 47.538 a	A 47.958 a	B 46.453 a	B 46.180 a	C 45.107 a	D 43.827 a
120 kg N/fad.	A 47.542 a	A 47.900 a	B 46.457 a	B 46.178 a	C 45.090 a	D 43.958 a
Regression coefficient	0.75	0.81	0.94	0.98	0.75	0.82
grain e						
30 kg N/fad.	AB 29.090 c	A 29.492 c	AB 28.632 c	B 28.560 c	-	-
60 kg N/fad.	AB 32.152 b	A 32.470 b	BC 31.233 b	C 31.197 b	-	-
90 kg N/fad.	A 34.333 a	A 34.363 a	B 32.987 a	B 32.650 a	-	-
120 kg N/fad.	A 34.335 a	A 34.463 a	B 32.983 a	B 32.733 a	-	-
Regression coefficient	0.60	0.84	0.74	0.70	-	-
grain f						
30 kg N/fad.	C 20.862 c	B 21.420 c	AB 21.200 c	A 22.022 c	-	-
60 kg N/fad.	C 22.550 b	B 23.748 b	B 23.367 b	A 24.637 b	-	-
90 kg N/fad.	A 26.190 a	A 26.222 a	B 25.362 a	A 26.413 a	-	-
120 kg N/fad.	A 26.177 a	A 26.238 a	B 25.405 a	A 26.432 a	-	-
Regression coefficient	0.98	0.85	0.73	0.75	-	-

D. Inter-intra spikelet competitions index (IISCI).

D.1. Cultivar differences :

It is interesting to note down here that as a general the intra cv was of greater than the inter-cv indicating that the magnitude of variation among single grain weights along rachilla was greater than among these weight along rachis. This is rather expected as Lesch *et al* (1992) indicated that grains along rachilla are connected in series whereas those along rachis are connected in parallel. Therefore, the competition among grains along rachilla is greater than the competition among grains along rachis. In other words, dry matter partitioning to grains along rachilla is more sensitive to the availability of assimilates than this partitioning to grains along rachis as they are to a great extent at par connected to the source of assimilates.

Data presented in Table (5) show that, Gemmiza 7 and Sakha 93 had greater inter cv than the other. But Sids groups had greater intra cv than Gemmiza 7 and sakha 93. Accordingly Sids groups recorded the lowest IISCI followed by Sakha 93 whereas the highest index was recorded by Gemmiza 7. This was observed in the first season and the combined. The increase of intra cv of Sids group could be attributed to the greater number of grains/spike (Table 1) Abdul-Galil (2000) found varietal differences in as observed herein.

D.2. Nitrogen level effect :

It is evident that the increase in N level from 30 to 120 kg N/fad. was accompained by a significant decrease in inter cv and intra cv. This was true in the two seasons and their combined analysis. But IISCI did not take a clear trend in the first season and did not vary significantly in the second season and their combined.

This trend strengthens the view that added N up to 90 kg N/fad. was quite enough as the last increment did not add significant increase regarding floral fertility within spikelet. These results indicate that though the number of grains/spike was fewer for the 30 or 60 kg N/fad. treatment, however, an intensive intra-spikelet competition have taken place among this fewer number and thus a greater variation was created among their weights as expressed in greater intra cv compared with the addition of 90 or 120 kg N/fad. This intensive intra-spikelet competition could be attributed to a shortage in the available assimilates for grain filling where grains in location a or b were filled on the expense of grains in location c, d and e (Table 4). This biased dry matter partitioning might have created more variation among

Table (5) : Inter and Intra-spikelet coefficients of variation (%) and Inter-Intra spikelet competition index (IISCI) as affected by cultivars and nitrogen levels in the two seasons and their combined.

Main effects and interactions	1999/2000			2000/2001			Combined		
	Inter-spikelet cv (%)	Intra-spikelet cv (%)	IISCI	Inter-spikelet cv (%)	Intra-spikelet cv (%)	IISCI	Inter-spikelet cv (%)	Intra-spikelet cv (%)	IISCI
Cultivars (V):									
Sids 5	7.604 b	27.75 a	0.275 c	8.742 cd	30.52 a	0.286 c	8.173 b	29.13 a	0.280 c
Sids 8	7.142 b	27.33 ab	0.261 c	9.233 bc	30.15 a	0.306 c	8.188 b	28.74 ab	0.283 c
Sids 9	7.347 b	26.70 b	0.274 c	8.464 d	29.84 a	0.283 c	7.905 b	28.27 b	0.279 c
Sids 10	7.172 b	27.01 ab	0.265 c	8.948 bcd	28.46 b	0.314 c	8.060 b	27.74 c	0.290 c
Gemmiza 7	9.322 a	7.567 c	1.238 a	9.516 b	7.982 c	1.212 b	9.719 a	7.775 d	1.225 a
Sakha 93	7.564 b	7.633 c	1.000 b	11.01 a	8.588 c	1.286 a	9.287 a	8.110 d	1.143 b
F. test	**	**	**	**	**	**	**	**	**
Nitrogen levels (N):									
30 kg N/fad.	8.750 a	22.36 a	0.566 a	10.72 a	24.58 a	0.614	9.736 a	23.47 a	0.590
60 kg N/fad.	7.656 b	20.56 b	0.573 a	9.273 b	22.91 b	0.612	8.464 b	21.73 b	0.593
90 kg N/fad.	7.097 c	19.88 c	0.521 b	8.731 c	21.55 c	0.628	7.914 c	20.71 c	0.575
120 kg N/fad.	7.264 c	19.85 c	0.549 ab	8.548 c	21.33 c	0.604	7.906 c	20.59 c	0.576
F. test	**	**	**	**	**	NS	**	**	NS
Interactions:									
VXN	*	**	**	NS	**	NS	*	**	NS

Table (5-a) : Inter and intra spikelet coefficients of variation (cv %) as affected by cultivars X N level interaction (combined).

	Sids 5	Sids 8	Sids 9	Sids 10	Gemmiza 7	Sakha 93
	Inter-spikelet coefficient of variation					
30 kg N/fad.	BC 9.185 a	B 9.552 a	B 9.558 a	C 9.012 a	A 10.608 a	A 10.503 a
60 kg N/fad.	B 7.897 b	B 8.007 b	B 7.875 b	B 8.310 b	A 9.173 b	A 9.525 b
90 kg N/fad.	C 7.878 b	CD 7.453 c	D 7.083 c	CD 7.477 c	A 9.093 b	B 8.498 c
120 kg N/fad.	B 7.732 b	B 7.738 bc	C 7.105 c	BC 7.443 c	A 8.800 b	A 8.620 c
Regression coefficient	-0.22	-0.30	-0.41	-0.28	-0.28	-0.33
	Intra-spikelet coefficient of variation					
30 kg N/fad.	A 31.497 a	A 30.963 a	B 30.212 a	B 29.948 a	C 8.908 a	C 9.292 a
60 kg N/fad.	A 30.070 b	B 28.940 b	C 28.185 b	C 27.673 b	E 7.410 b	D 8.117 b
90 kg N/fad.	A 27.483 c	A 27.520 c	A 27.607 bc	B 26.705 c	C 7.423 c	C 7.538 b
120 kg N/fad.	A 27.482 c	A 27.528 c	AB 27.065 c	B 26.612 c	C 7.357 c	C 7.495 b
Regression coefficient	-0.73	-0.59	-0.50	-0.55	-0.23	-0.30

average weights of grains along rachilla and hence increased intra cv of 30 kg N/fad. treatment.

D.3. Interaction effect :

The interaction between cultivars and N levels affected significantly IISCI in the first season but the combined analysis did not ascertain such effect. However, this interaction affected both inter and intra spikelet cv as presented in (Table 5-a)

It is evident from Table (5-a) that the increase of N level over 30 kg N/fad. to different levels, which varied among wheat cultivars, was effective to decrease both the inter and intra – spikelet competitions. The decrease was higher in the intra – than the inter – spikelet competition. Also, the decrease was much higher in Sids 5 (-0.73) followed by Sids 8 (-0.59) than in the other wheat cultivars under study. These data again strengthen the view that Sids 5 followed by Sids 8 were much more favoured by the increase of N level as indicated by a noticeable decrease in the within spikelet competition.

Data in Table (4-a) clearly indicated that distal grains (e) and (f) of Sids 5 and Sids 8 made better use of added N as indicated by their greater response and in particular grain (f) to the increase of N level. This response could be attributed to the more decrease of intra–spikelet competition due to the increase of N level which was more evident in Sids 5 and Sids 8 as forementioned.

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تأثير التسميد النيتروجينى على محصول وخصوبة الزهيرات والمنافسة بين وداخل السنيبلات فى بعض أصناف القمح بالأراضى الرملية

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أقيمت تجربتان حقليتان خلال موسمى ١٩٩٩/٢٠٠٠، ٢٠٠٠/٢٠٠١ بمحطة التجارب الزراعية بكلية الزراعة – جامعة الزقازيق بالخطارة - محافظة الشرقية تحت ظروف الرى بالرش بالأراضى الرملية لدراسة تأثير أربع مستويات من التسميد النيتروجينى (٣٠ ، ٦٠ ، ٩٠ و ١٢٠ كجم ن/ف) على محصول وخصوبة الزهيرات وكذلك المنافسة بين وداخل السنيبلات لست أصناف من قمح الخبز وهى سدس ٥ ، سدس ٨ ، سدس ٩، سدس ١٠، جميزة ٧، سخا ٩٣ ويمكن تلخيص أهم النتائج على النحو التالى:

(١) إختلفت أصناف القمح معنويا فى جميع الصفات تحت الدراسة حيث تميز الصنف سدس ٩ فى مساحة ورقة العلم ومحتواها من الكلوروفيل ، طول السنبلة ، عدد السنيبلات الخصبة / السنبلة وعدد ووزن حبوب السنبلة وبالتالى محصول الحبوب / فدان عن باقى الأصناف فى حين تفوق الصنفان سدس٥ وسدس ٨ فى وزن الألف حبة بينما أظهر الصنفان جميزة ٧ وسخا ٩٣ تفوقا فى عدد السنابل /م٢ ومحصول القش / فدان كما تفوق جميزة ٧ بزيادة فى ارتفاع النبات عن باقى الأصناف .

(٢) تفوقت أصناف القمح طويلة السنبلة سدس ٥ ، سدس ٨ ، سدس ٩ وسدس ١٠ فى عدد السنيبلات والحبوب / السنبلة وكذلك وزن الألف حبة وبالتالى وزن حبوب السنبلة ومحصول الحبوب / فدان ورتبت الأصناف تنازليا حسب كمية محصول الفدان من الحبوب كالأتى : سدس ٩ ، سدس ٨، سدس ١٠، سدس ٥ ، سخا ٩٣ وجميزة ٧

(٣) أوضح توزيع متوسط وزن الحبة على محور السنبلة تميز الصنفان سدس ٥ وسدس ٨ عن باقى الأصناف حيث كان متوسط وزن الحبة فيهما أعلى عند جميع مواقع السنيبلات على السنبلة بإستثناء الموقع الثالث حيث تساوى معهما الصنف سدس ١٠ . كما تفوق هذان

الصنفان بالنسبة لمتوسط وزن الحبة للمواقع المختلفة على محور السنيبلة ما عدا موقع الحبة f حيث تفوق الصنف سدس ١٠ .

(٤) أوضح التحليل التجميعي للموسمين زيادة قيمة المنافسة بين السنيبلات للصنفان جميزه ٧ وسخا ٩٣ عن مجموعة الأصناف طويلة السنبلة وبالتالى زادت قيمة دليل المنافسة بين وداخل السنيبلات (IISCI) لهذان الصنفان عن باقى الأصناف والتى تجاوزت الوحدة (١,٢٢٥ ، ١,١٤٣ على الترتيب) فى حين زادت قيمة المنافسة داخل السنيبلات للصنفان سدس٥ وسدس٨ وبصفة عامة كانت قيمة المنافسة داخل السنيبلات أعلى من قيمة المنافسة بين السنيبلات.

(٥) أدى زيادة معدل التسميد النيتروجينى من ٣٠إلى ٦٠ إلى ٩٠ أو ١٢٠ كجم ن/ف لزيادة معنوية فى محصول الحبوب والقش ومؤشراتهما ، متوسط وزن الحبة على محور السنيبلة ومتوسط وزنها على محور السنبلة مما ساعد على خفض قيم المنافسة بين وداخل السنيبلات

(٦) أظهر تداخل الفعل بين الأصناف ومستويات النيتروجين تأثير معنوى على صفات ارتفاع النبات ، وزن الألف حبة ، وزن حبوب السنبلة ومحصول الحبوب للفدان ولوحظت استجابة صنفية لمستويات النيتروجين حيث كانت استجابة الأصناف التابعة لمجموعة سدس أعلى من استجابة الصنفان جميزة ٧ وسخا ٩٣ لمستويات النيتروجين وذلك يفسر زيادة محصول الحبوب لهذه الأصناف .

(٧) لوحظت استجابة صنفية لزيادة مستويات النيتروجين حيث زاد متوسط وزن الحبة على المواقع من (أ) إلى (و) على محور السنيبلة بزيادة مستويات النيتروجين وكان التأثير اكثر وضوحا للحبة (ج) عموما والحبوب الطرفية (هـ ، و) فى الأصناف طويلة السنبلة عن الصنفان جميزة ٧ وسخا ٩٣ .

(٨) أوضحت نتائج التحليل التجميعي للموسمين لتداخل الفعل بين الأصناف ومستويات النيتروجين أن الصنف سدس ٥ يمكن أن يسجل أعلى محصول (١,٩٩٨ طن / فدان) عند زيادة مستوى التسميد النيتروجينى حتى ١٣١,٦ كجم ن / فدان على حين يتحقق أعلى عائد من عملية التسميد (١٠٩٠,٣ جنيه) عند إضافة أمثل معدل تسميد (١٠٩,١ كجم ن / فدان) لهذا الصنف ويليه من حيث العائد الصنف سدس ٩ حيث يحقق (١٠٧٤,٢ جنيه) من محصول اقتصادى ينتج من إضافة (١٠٥,٦ كجم ن / فدان) .