Egypt. J. Agron. **Vol. 34**, No. 1, pp. 1-17 (2012)

Response of Four New Bread Wheat (*Triticum aestivum* L.) Cultivars to Nitrogen Fertilizer Levels under Sprinkler Irrigation System in Sandy Soils

I.M. Abd El-Hameed
Department of Agronomy, Faculty of Agriculture, Zagazig University, Sharkia, Egypt.

TWO FIELD experiments were carried out in the Experimental Farm of Faculty of Agriculture in El-Khattara Region, Zagazig University, Egypt during two successive winter seasons (2009/2010–2010/2011). The experiments aimed to study the response of some new bread wheat cultivars (Egypt 1, Sakha 94, Sids 12 and Sids 13) to nitrogen fertilizer levels (50, 75 and 100 kg N/fed) under sprinkler irrigation in sandy soils.

Results could be summarized as follows:

1-Significant differences were detected among the four wheat cultivars in all studied characters during the two seasons and their combined analysis. Where, wheat cultivar Sids 13 followed by Sids 12 and Egypt 1 recorded the highest values regarding spike length (cm), number of spikelets per spike, number of grains per spike, grain weight (gm) per spike and grain yield (ardab per fed), while wheat cultivar Sakha 94 gave the lowest values in all aforementioned traits except plant height in both seasons and their combined analysis.

2- The increase of N level from 50 to 75 and up to 100 kg N/fed led to significant increase in aforementioned characters in both seasons and their combined analysis.

3- Grain yield reached its maximum values, *i.e.* 11.4 and 11.8 ardab per fed when plants were fertilized with 112.5 and 93.6 kg N per fed for both wheat cultivars Sids 12 and Sids 13,respectively. The results , further indicated that, optimum yields were 10.83 and 11.74 ardab per fed and could be obtained when 75 and 78.9 kg N per fed were added for both wheat cultivars Sids 12 followed by Sids 13, respectivley.

Keywords: Wheat, Cultivars, Nitrogen, Sprinkler irrigation , Sandy soils.

Bread wheat (*Triticum aestivum* L.) is considered to be one of the most important cereal crops in the world as well as in Egypt (FAO, 2007). In Egypt, the national production of cereals is relatively lower than the consumption demands. Raising wheat production through increasing the productivity per area unit is the most important national target to minimize the gap between the

Egyptian production and annual local demand. Improving productivity could be achieved by cultivating high yielding cultivars coupled with improved agronomic practices such as nitrogen fertilizer application. Many workers showed that wheat cultivars differ in yield and yield components. Ashmawy & Abo-Warda (2002) showed that wheat cv. Giza-168 significantly surpassed Sids-1 and Gemmeiza-9 cultivars in grain yield per fed, number of grains per spike and 1000-grain weight, Moreover, Abd El–Hmeed (2005) concluded that, wheat cultivar Giza-168 gave higher values of number of spikelets per spike, number of grains per spike, 1000-grain weight and grain yield per fed than Sakha-93 one. Gafar (2007), Ramadan & Awaad (2008) and El-Murshedy (2008) stated that, the varietals differences significantly affected plant height, spike length, number of spikelets and grains per spike, grain weight per spike and grain yield per fed. Zeidan *et al*. (2009) stated that, significant differences were detected among three wheat cultivars, where, Sids 1 was superior and gave the highest values per no. of grains per spike, grain weight per spike, 1000-grain weight and grain yield per fed followed by Giza 168 ,while Sakha 93 produced the lowest values in all studied chracters. However, Amin *et al*. (2010) reported that, wheat cultivar Gemmeiza 9 gave the highest number and heaviest grains per spike and grain yield followed by Sakha 93 and Giza 168. On the contrary, Saleh (2003) did not find any effect of varietal differences on grain yield per feddan.

Nitrogen plays an important role in plant life and is considered an indispensable element for several vital functions. Abd El–Hmeed & Omar (2006) concluded that, increasing N level up to 105 kg N/fed significantly increased each of spike length, number of spikelets and grains per spike, 1000-grain weight and grain yield per fed. Shaaban (2006) reported significant increase in grain yield per fed of wheat grown under sandy soil conditions due to the increase of N level up to 40 kg per fed with organic nitrogen addition. Gafar (2007) found that no. of spikelets and grains per spike, 1000- grain weight and grain yield responded to the increase of N level up to 60 kg N per fed while, plant height responded to 90 kg N per fed. Weber *et al.* (2008) pointed out that the increase of N level up to 180 kg per hectare (75.6 kg N per fed) was effective to increase grain yield per ha. Ahmed *et al*. (2009) reported that, doubling the level of added N to 100 kg per fed was accompanied by a significant increase in plant height, no. of spikelets and grains per spike,1000- grain weight and grain yield per fed. Zeidan *et al.* (2009) stated that, increasing N fertilizer level up to 120 kg per fed significantly increased no. of grains per spike, grain weight per spike, 1000-grain weight and grain yield per feddan.

The present investigation aimed to study the response of some new bread wheat cultivars (Egypt 1, Sakha 94, Sids 12 and Sids 13) to nitrogen fertilizer levels (50, 75 and 100 kg N per fed) in sandy soil conditions under sprinkler irrigation system.

Materials and Methods

Two field experiments were carried out in the Experimental Farm of Faculty of Agriculture, Zagazig University, in the El-Khattara Region, Sharkia Governorate, Egypt during two winter successive seasons (2009/2010–2010/2011). The experiment aimed to study the response of some bread wheat *(Triticum aestivum* L.) cultivars (Egypt 1, Sakha 94, Sids 12 and Sids 13) to nitrogen fertilizer levels (50, 75 and 100 kg N per fed) in sandy soil conditions under sprinkler irrigation system. The experimental field soil was sandy in texture, had an average pH value of 7.7 ;0.51organic matter and had 12.5, 3.4 and 132 ppm available N, P and K, respectively (averaged over of the two seasons for the upper 30 cm of soil depth). Each experiment included 12 treatments which were the combination of four bread wheat cultivars (Egypt 1, Sakha 94, Sids 12 and Sids 13) and three levels of nitrogen fertilizer (50,75 and 100 kg N per feddan) .

A split- plot design with three replicates was followed, cultivars were assigned to the main plots, whereas, nitrogen fertilizer levels were allocated in the sub plots. The area of plot was 5.0 m^2 (2.5 m in length and 2.0 m in width) included 10 rows, 20 cm apart. Seeds (450 grains per m^2) were hand drilled on December 10^{th} and 14^{th} in the first and second seasons, respectively. Phosphorous fertilizer was applied during soil preparation in the form of calcium super phosphate (15.5% P_2O_5) with 31.0 kg P_2O_5 per feddan, other normal cultural practices of wheat were applied properly as recommended for the region.

Response to nitrogen fertilization

The present study seeks to find out the differential response of the four newly released bread wheat cultivars to N fertilizer levels. Significance of four cultivars response to N increments and the significant NxCvs interactions were calculated according to Snedecor & Cochran (1981), using the orthogonal polynomial Tables. Significance of the linear and quadratic components of each of the equations was tested and hence the response could be described as linear (first order) or quadratic (second order). The predicted maximum (Y_{max}) and optimums (Y_{opt}) of grain yields, as well as, the predicted maximum (X_{max}) and optimum (X_{opt}) N levels were calculated according to Sukhatme (1941), as follows:

$Y^{\wedge} = a+bx-cx2$ $Y^{\wedge}_{opt.} = Y0 + (b-r)2/4\ c$, $(X_{max}) = X_0 + b/2c\ (u)$.
$X_{opt.} = X0 + b-r/2c\ (u)$ $Y_{max} = Y_0 + b2/4c$.
where: Y_0 =Grain yield at the lowest N level (X0) *i.e.* 50 kg N /fed (ardab / feddan).
b = Measures the linear components of the response equation.
c = Measures the quadratic components of the response equation.
r =q/p q = Cost of N unit (u) *i.e.* 50 kg N /fed = 120.0 L.E.
p = Price of a unit yield (ardab) = 400 L.E.
u= The interval between levels of N

For all characters under study the predicted maximum averages which could have been obtained if the N level was increased to a certain maximum, *i.e.* $X_{max.}$ were also calculated in order to define the yield limiting components.

The studied cultivars used were: 1-Egypt 1, 2-Sakha 94, 3-Sids 12, 4-Sids 13. Nitrogen in form of ammonium sulfate (20.5% N) was supplied in seven equal doses at 10, 20, 30, 40, 50, 60 and 70 days after sowing. Wheat was sown after a fallow in the two seasons. A fixed rate of 50 kg K_2O per feddan of potassium sulphate (48% K_2O) was given in equal portions at sowing and heading. Sprinkler irrigation was scheduled at an almost one week interval during winter and this period was shortened to four or five days from the beginning of spring up to fifteen days before harvest. Harvest was done during the last week of April in the first and second seasons. Sample of ten guarded plants were taken from each plot to measure: (1) Height of wheat plant (from soil surface up to spike tip), ten spikes were randomly selected from each treatment to measure. (2) Spike length (cm). (3) Number of spikelets per spike. (4) Number of grains per spike. (5) Grain weight per spike (g). (6) Thousand grain weight (g), the inner seven rows of each sub- plot by a long of 1.5 m (2.10 m^2) were harvested to determine. (7) Grain yield (ardab per feddan).

Statistical analysis of each experiment was performed as the methods outlined by Steel & Torrie (1980). Significancy of differences between the various means of different characters under study was compared with the help of Duncan's multiple range test (1955). In the interaction tables, capital and small letters were used for the comparison among rows and columns means, respectively.

Results and Discussion

Plant height (cm), spike length (cm) and number of spikelets per spike

Effect of cultivar

Results presented in Table 1 show that, plant height, spike length and number of spikelets per spike of the four wheat cultivars in both seasons and their combined were affected by cultivars. It was evident (from the- combined analysis) that wheat cultivar Sids 13 surpassed in spike length (9.66 cm) and number of spikelets per spike (16.53) the other three cultivars (Sids 12 , Egypt 1 and Sakha 94). Meanwhile, wheat cultivar Sakha 94 produced the lowest values (8.45 cm in spike length and 15.45 spikelet per spike). The differences in plant height were significant where, wheat cultivar Sakha 94 showed the highest values (83.45 cm) while, the other three wheat cultivars were lowest. The differences in plant height and number of spikelets per spike among the evaluated four wheat cultivars might be attributed to the genetic variations. Similar result was found by Ashmawy & Abo-Warda (2002), Hassan *et al.* (2002), Abd El–Hmeed (2005), Zeidan *et al*. (2005), Gafar (2007), Ramadan & Awaad (2008), Ahmed *et al*. (2009) and Amin *et al.* (2010).

TABLE 1. Plant height , spike length and number of spikelets per spike of wheat as affected by cultivars and nitrogen fertilizer levels during two successive seasons (2009/2010- 2010/2011) and their combined analysis.

Main effects and interaction	Plant height(cm)			Spike length(cm)			Number of spikelets per spike		
	2009/2010	2010/2011	Comb.	2009/2010	2010/2011	Comb.	2009/2010	2010/2011	Comb.
Cultivars (C)									
Egypt 1	77.27b	78.15b	77.71b	8.87ab	9.1b	8.98b	15.03c	16.07bc	15.55c
Sakha 94	82.74a	84.16a	83.45a	8.33b	8.68b	8.45b	14.97c	15.96c	15.45c
Sids 12	75.13b	76.28b	75.71b	9.46a	9.85a	9.66a	15.31b	16.25b	15.78b
Sids 13	78.13b	78.22b	78.41b	9.56a	9.75a	9.66a	16.02a	17.03a	16.53a
F-test	**	**	**	**	*	**	**	**	**
$L.S.D_{05}$	3.94	3.39	3.59	0.716	0.599	0.63	0.185	0.194	0.165
Nitrogen fertilizer levels (N)									
50 kg N/fed.	73.73b	75.27c	74.50c	8.4c	8.75c	8.57c	14.72c	15.73c	15.24c
75 kg N/fed.	78.94a	79.02b	78.98b	9.1b	9.35b	9.17b	15.40b	16.39b	15. 90b
100 kg N/fed.	82.29a	83.7a	82.98a	9.7a	9.93a	9.82a	15.85a	16.87a	16.36a
F-test	**	**	**	**	**	*	**	**	**
$L.S.D_{05}$	3.41	2.94	3.112	0.62	0.519	0.545	0.16	0.178	0.143
Interaction									
C.N.	NS	NS	NS	NS	NS	NS	*	NS	*

NS, * and **: indicate Not significant, significant and highly significant at 0.05 and 0.01 level, respectively. Comb. = combined, C: cultivars, N: nitrogen fertilizer levels and Fed. :feddan = 4200 m^2 = 0.42 hectare.

Effect of nitrogen

Regarding the influence of nitrogen fertilization, the results in Table 1 revealed significant differences between the two seasons and their mean values. Raising nitrogen fertilizer level from 50 to 75 and up to 100 kg N/fed, led to gradual increase in plant height, spike length and number of spikelets per spike of wheat plants. Therefore, the highest values of these traits were achieved by the addition of the highest rate of N (100 kg N /fed), while the low rate of 50 kg N per fed resulted in lowest one. The average increase for the mean of both seasons for 1st and 2nd N- increment reached about 6 and 11.4 % for plant height, 7 and 14.6 % for spike length and 8.1 and 7.7% for no. of spikelets per spike, respectively. Such increment in plant height, spike length and number of spikelets per spike accompanied with increasing N level might be attributed to the stimulation of internodes elongation and enhanced growth. The positive role of nitrogen in plant height, spike length and number of spikelets per spike of wheat is extensively reported in the literature where many authors got significant increase in traits due to addition of nitrogen up to 60 kg N per fed. These results are similar with those obtained by Mohamed *et al.* (2001), Abd El- Hmeed (2005) and Abd El–Hmeed & Omar (2006) and Ahmed *et al*. (2009).

Interaction effect

As shown in the combined analysis, the interaction effect between the four bread wheat cultivars and nitrogen fertilizer levels on number of spikelets per spike were significant (Tables 1 and 1-a). It was quite clear from these tables that addition of N has increased the response of no. of spikelets per spike to N increments, this response was linear when N was added up to 100 kg N per fed for the three cultivars (Sakha 94, Sids 12 and Sids 13) indicating the need for more N than the highest level tried in this study in order to maximize no. of spikelets per spike for all cultivars . But, this response was quadratic in the number of spikelets per spike when using Egypt 1. There was a significant decrement of -0.645 gram per spike, indicating a significant bending in the response curve. Also, receiving wheat cultivar plants Sids 13 the highest amount of nitrogen dose (100 kg N per fed) gave the highest value of that trait (16.45 spikelet per spike) while, the lowest value (14.23 and 14.4 spikelet per spike) was obtained by the cultivars Egypt 1 and Sakha 94 when plants received the lowest dose of nitrogen (50 kg N per fed).

Number of grains and its weight per spike (g)

Effect of cultivars

Results presented in Table 2 show that, number of grains per spike and grain weight per spike of the four bread wheat cultivars in both seasons and their combined were significantly different. It was evident that the highest means of the previous characters (39.67 grain per spike and 2.13 gram for grain per spike) were obtained by using wheat cultivar Sids 13 when compared with the other cultivars Sids 12, Egypt 1. Meanwhile, wheat cultivar Sakha 94 produced the lowest values (37.37 grain per spike and 1.77 gram for grains per spike). The differences in number of grains per spike and grain weight per spike (g) among the evaluated bread wheat cultivars might be attributed to the genetically variations. Similar results were reported by Ashmawy & Abo-Warda (2002), Hassan *et al.* (2002), Abd El–Hmeed (2005), Tabl *et al.* (2005), Zeidan *et al.* (2005), EL-Sawi *et al*. (2006), Gafar (2007), Ramadan & Awaad (2008), El-Murshedy (2008), Ahmed *et al*. (2009) and Amin *et al*. (2010).

TABLE (1-a). Number of spikelets per spike of wheat as affected by the interaction between cultivars and nitrogen fertilizer levels , as well as , response equations and predicted maximum number of spikelets per spike (Y max) and N level (X max) in the combined data.

Nitrogen fertilizer levels and wheat cultivars	50kgN/fed	75kgN/fed	100kgN/fed	Average	$\hat{Y}$=a+bx-cx2	X max (NL)	Y max	X Opt. (NL)	Y Opt.
Egypt 1	BC 14.23c	BA 15.36 c	A 15.56 c	15.o5	14.23 + 1.595 X -0.645 X2	92.87	15.59	84.81	15.13
Sakha 94	CB 14.40 c	B 14.96d	A 15.48d	14.94	14.4 + 0.58 X -0.02 X2	------	------	------	-------
Sids 12	C 14.80 b	BA 15.25 b	A 15.80 b	15.28	14.8 + 0.6 X + 0.05 X2	-------	------	------	------
Sids 13	AB 15.48a	A 16.00a	A 16.45a	15.97	15.48 + 0.555 X -0.035 X2	——	——	——	——
Average	14.7	15.4	15.8						

Analysis according to Sukhatme (1941) as explained by Abdul Galil *et al.*, (2003).

$Y^{\wedge}$= a+bx-cx2, $Y^{\wedge}_{opt.}$= Y_0 + (b-r)2/4c, (X_{max}) = X_0 + b/2c (u) $X_{opt.}$ = X_0+ b-r/2c (u) Y_{max} =Y_0 +b2/4c

where: Y_0 = number of spikelets per spike at the lowest N level (X_0), *i.e.* 50 kg N /fed. X opt. = optimum N levels (kg/fed), X max. = maximum N levels (kg/fed.), Y opt. = optimum number of spikelets per spike and Y max = maximum number of spikelets per spike. b = Measures the linear components of the response equation. c = measures the quadratic components of the response equation. r =q/p, q = Cost of N unit (u) *i.e.* 50 kg N / fed. = 120.0 L.E. p = price of a unit yield (ardab) = 400 L.E., Ardab = 150 kg = 0.15 from ton u = the interval between levels of N, feddan= 0.42 hectare.

TABLE 2. Number of grains per spike and grain weight spike of wheat as affected by cultivars and nitrogen fertilizer levels during the two successive seasons (2009/2010 and 2010/2011) and their combined analysis.

Main effects and interaction	Number of grains per spike			Grain weight spike (gm)		
	2009/2010	2010/2011	Comb.	2009/2010	2010/2011	Comb.
Cultivars (C)						
Egypt 1	38.48b	39.4b	38.94b	1.78c	2.00c	1.89c
Sakha 94	37.31c	37.43c	37.37c	1.65d	1.88d	1.77d
Sids 12	38.38b	39.61b	39.00b	1.90b	2.09b	2.00b
Sids 13	38.96a	40.37a	39.67a	2.05a	2.21a	2.13a
F-test	**	**	**	**	**	**
$L.S.D_{05}$	0.363	0.311	0.237	0.036	0.038	0.022
Nitrogen fertilizer levels (N)						
50 kg N/fed	37.03c	38.00c	37.52c	1.77c	1.97b	1.87c
75 kg N/fed	38.43b	39.65b	39.04b	1.83b	2.03a	1.93b
100 kg N/fed	39.39a	40.37a	39.88a	1.92a	2.13a	2.03a
F-test	**	**	**	**	**	**
$L.S.D_{05}$	0.314	0.269	0.205	0.031	0.033	0.019
Interaction						
C.N.	*	*	*	*	NS	*

NS, * and **: indicate Not significant, significant and highly significant at 0.05 and 0.01 level, respectively. Comb.=combined, C: cultivars, N; nitrogen fertilizer levels and Fed : feddan=4200 m^2 =0.42 hectare.

Nitrogen effect

Regarding the influence of nitrogen fertilizer levels the results in Table 2 revealed significant differences in the two seasons and the combined analysis. Raising nitrogen fertilizer level from 50 to 75 and up to 100 kg N per fed, led to gradual increase in number of grains per spike and grain weight per spike (g). Therefore, the highest values of number of grains per spike (39.88) and grain weight per spike (2.03 gram) were achieved by addition the highest dose of N (100 kg N per fed), while the lowest dose of 50 kg N/fed produced the lowest one (37.52 grain per spike and 1.87 weight of grains per spike). The average increase for the mean of both seasons for 1^{st} and 2^{nd} N- dose reached about 4.6 and 7.0% for number of grains per spike and 9.0 and 12.2% for grain weight per spike, respectively. Such increments might be attributed to the positive role of nitrogen in increasing photosynthesis activity which cause more flower fertility and setting per spike, and stimulation the plant capacity in building more metabolites which translocate to develop grains and increase grain weight. Several investigators, came to the same conclusion; included Mohamed *et al.* (2001) Abd El-Hmeed (2005) , Abd El–Hmeed & Omar (2006) and Ahmed *et al.* (2009).

Interaction effect

Data of the mean of both seasons, show significant interaction effect between the four bread wheat cultivars and nitrogen fertilizer levels on no. of grains per spike and its weight in Tables 2, 2-a and 2-b, respectively. It was quite clear from these tables that addition of N has increased the response of number of grains and its weight per spike to N increments, this response was linear when N was added up to 100 kg N per fed indicating that more N than the highest level tried in this study is needed in order to maximize number of grains per spike and grain weight per spike for all cultivars. But, this response was quadratic in grain weight per spike when using Sids 12. There was a significant decrement of -0.045 gram per spike, indicating a significant bending in the response curve. The data indicate that receiving the cultivar Sids 13 the highest amount of nitrogen dose (100 kg N per fed) produced the highest values of that traits (40.56 grain per spike and 2.09 gram of grains per spike) while, the lowest values (35.73 grain per spike and 1.56 gram of grains per spike) were recorded by the cultivar Sakha 94 which, received the low amount of nitrogen dose (50 kg N/feddan).

1000-grain weight (g) and grain yield (ardab per feddan)

Cultivars effect

Data given in Table 3 clearly indicate that, wheat cultivar Sids 13 produced, the heaviest grains expressed as 1000-grain weight (39.60 gram), and the highest grain yield (11.49 ardab per fed) followed by wheat cultivar Sids 12 and Egypt 1 (38.01 and 37,33 gm and 11.04 and 10.81 ardab per fed for previous traits, respectively. At the same time, wheat cultivar Sakha 94 recorded the lowest means (36.88 g and 10.13 ardab per fed for previous traits, respectively). The differences in 1000-grain weight (g) and grain yield (ardab per feddan) among the evaluated four wheat cultivars might be attributed to the genetic variations. Similar observations were found by Ashmawy & Abo-Warda (2002), Hassan *et al.*, (2002), Abd El–Hmeed (2005), Zeidan *et al*. (2005), Tabl *et al*. (2005), EL-Sawi *et al*. (2006), Gafar (2007), El-Murshedy (2008), Ramadan & Awaad (2008), Ahmed *et al*. (2009) and Amin *et al*. (2010) while, Saleh (2003) did not find any effect of varieties on grain yield per feddan.

Nitrogen effect

Regarding the influence of nitrogen fertilization, the results revealed highly significant differences in the two seasons and their combined analysis. Meanwhile, raising nitrogen fertilizer level from 50 to 75 and up to 100 kg N per fed, increased 1000-grain weight (gm) and grain yield (ardab per fed). Here, it can be noticed that the increase in grain yield (ardab per fed) caused by N- level of 100 kg N per fed is in accompanied with the increase in spike length and no. of spikelets per spike (Table 1), consequently, no. of grains per spike and grain weight per spike (Table 2) and thousand grain weight (Table 3) increased with application of N up to the highest level tested (100 kg N per fed). The average increase for the mean of both seasons for 1^{st} and 2^{nd} N- increment reached about 0.9 and 3.7% for thousand grain weight and 4.2 and 6.0% for grain yield, respectively. These results are in harmony with those obtained by Mohamed *et al*. (2001), Abd El- Hmeed (2005), Abd El–Hmeed & Omar (2006), Weber *et al*. (2008) and Ahmed *et al*. (2009).

TABLE (2-a). Number of grains per spike of wheat as affected by the interaction between cultivars and nitrogen fertilizer levels, as well as, response equations and predicted maximum number of grains per spike (Y max) and N level (X max) in the combined data.

Nitrogen fertilizer levels and wheat cultivars	50kg N/fed.	75kgN/fed.	100kgN/fed	Average	^ Y=a+bx-cx2	X max	Y max
Egypt 1	CB 37.56 a	B 38.41 c	A 39.35 c	38.44	37.56 +0.985 X+ 0.045 X2	------	------
Sakha 94	B 35.73 b	A 36.97 d	A 37.9 d	36.86	35.73 +1.395 X+0.155 x2	…….	…….
Sids 12	CB 37.14 a	B 38.61 b	A 39.73 b	38.49	37.14 +1.645X -0.35 X2	------	------
Sids 13	C 37.78a	AB 39.16a	A 40.56a	39.16	37.78 +1.41 X +0.01 X2		
Average	37.1	38.3	39. 4				

Analysis according to Sukhatme (1941) as explained by Abdul Galil *et al.* (2003).

$\hat{Y}$= a+bx-cx2, $\hat{Y}_{opt.}$= Y_0 + (b-r)2/4c, (X_{max}) = X_0 + b/2c (u) $X_{opt.}$ = X_0+ b-r/2c (u) Y_{max} =Y_0 +b2/4c

where: Y_0 = number of grains per spike at the lowest N level (X_0), *i.e.* 50 kg N /fed. X opt. = optimum N levels (kg/fed.), X max. = maximum N levels (kg/fed.), Y opt. = optimum number of grains per spike and Y max = maximum number of grains per spike. b = measures the linear components of the response equation. c = measures the quadratic components of the response equation. r =q/p, q = Cost of N unit (u) *i.e.* 50 kg N / fed. = 120.0 L.E. p = price of a unit yield (ardab) = 400 L.E., Ardab=150 kg =0.15 from ton, u= the interval between levels of N, feddan = 0.42 hectare.

TABLE (2-b). Grain weight per spike of wheat as affected by the interaction between cultivars and nitrogen fertilizer levels, as well as , response equations and predicted maximum grain weight (gm) per spike (Y max) and N level (X max) in the combined data.

Nitrogen fertilizer levels and wheat cultivars	50kg N/fed.	75kg N/fed	100kg N/fed	Average	^ Y=a+bx-cx2	X max (NL)	Y max (gm)	X Opt. (NL)	Y Opt. (gm)
Egypt 1	B 1.71 c	B 1.79 bc	A 1.86 b	1.8	1.71 + 0.085 X	……..	……..	…….	…….
Sakha 94	C 1.56 d	B 1.66 c	A 1.77 c	1.7	1.56 +0.115X +0.005X2	…….	……..	…….	……..
Sids 12	C 1.83 b	BC 1.86 b	A 1.98 a	1.9	1.83 + 0.165X -0.045 X2	95.83	1.98	87.5	1.93
Sids 13	B 1.97a	A 2.02a	A 2.09a	2.0	1.97 +0.08X +0.01X2	……..	……..	…….	…….
Average	1.8	1.84	1.91						

Analysis according to Sukhatme (1941) as explained by Abdul Galil *et al.*, (2003).

$\hat{Y}$= a+bx-cx2, $\hat{Y}_{opt.}$= Y_0 + (b-r)2/4c, (X_{max}) = X_0 + b/2c (u) $X_{opt.}$ = X_0+ b-r/2c (u) Y_{max} =Y_0 +b2/4c

where: Y_0 = grain weight (gm) per spike at the lowest N level (X_0), *i.e.* 50 kg N /fed . X opt. = optimum N levels (kg/fed), X max. = maximum N levels (kg/fed), Y opt. = optimum grain weight (gm) per spike and Y max = maximum grain weight (gm) per spike . b = Measures the linear components of the response equation. c = measures the quadratic components of the response equation. r =q/p, q = cost of N unit (u) *i.e.* 50 kg N / fed. = 120.0 L.E.p = price of a unit yield (ardab) = 400 L.E., Ardab=150 kg=0.15 from ton, u= the interval between levels of N, feddan= 0.42 hectare.

TABLE 3. 1000-grain weight and grain yield of wheat as affected by cultivars, nitrogen fertilizer levels during the two successive seasons (2009/2010 and 2010/2011) and their combined analysis.

Main effects and interaction	1000-grain weight(gm)			Grain yield (ardab per fed)		
	2009/2010	2010/2011	Comb.	2009/2010	2010/2011	Comb.
Cultivars (C)						
Egypt 1	36.84c	37.82c	37.33c	10.85b	10.77c	10.81c
Sakha 94	36.37d	37.38d	36.88d	9.94c	10.32d	10.13d
Sids 12	37.62b	38.40b	38.01b	10.99b	11.09b	11.04b
Sids 13	38.90a	40.30a	39.60a	11.54a	11.40a	11.49a
F-test	**	**	**	**	**	**
$L.S.D_{05}$	0.404	0.278	0.266	0.154	0.169	0.118
Nitrogen fertilizer levels (N)						
50 kg N/fed	36.76c	37.62c	37.19c	10.53c	10.50c	10.51c
75 kg N/fed	37.38b	38.45b	37.92b	10.88b	10.99b	10.95b
100 kg N/fed	38.16a	39.35a	38.76a	11.08a	11.20a	11.14a
F-test	**	**	**	**	**	**
$L.S.D_{50}$	0.35	0.24	0.23	0.133	0.146	0.102
Interaction						
C.N.	NS	NS	*	*	*	*

NS, * and **: indicate Not significant, significant and highly significant at 0.05 and 0.01 level, respectively. Comb. =combined, C: cultivars, N; nitrogen fertilizer levels and fed : feddan=4200 m^2 =0.42 hectare.

However, Shaaban (2006) reported significant increase in grain yield per fed of wheat grown under sandy soil conditions due to the increase of N level up to 40 kg per fed with organic nitrogen addition.

Interaction effect

Data of the mean of the two seasons, show significant interaction effect between the four cultivars and N fertilizer level on 1000-grain weight (Table 3-a) and grain yield (Table 3-b). It was quite clear from these tables that the addition of N has increased the response of 1000-grain weight to N increments, this response was linear when N was added up to 100 kg N per fed for all cultivars indicating the need for more N than the highest level tried in this study in order to maximize that trait. Also, each N increment produced a linear increase of 0.12, 0.54 , 0.50 and 0.82 ardab per fed. for cultivars Egypt 1 , Sakha 94, Sids 12 and Sids 13 , respectively and a significant decrement were -0.1 and -0.24 ardab per fed for Sids 12 and Sids 13 , respectively. Hence, high grain yield maximum of 11.4 and 11.8 ardab per fed obtained if high N levels of 112.5 and 93.6 kg N per fed for Sids 12 and Sids 13 , respectively are added. Results, further indicated that, optimum yields were 10.83 and 11.74 ardab per fed could be obtained when 75 and 78.9 kg N per fed were added for Sids 12 and Sids 13 , respectively. It can be seen that planting wheat cultivar Sids 13 which receiving the higher dose of N (100 kg N/fed) gave the higher values of 1000-grain weight (40.10 g) as well as grain yield (11.79 ardab per feddan) than those receiving 50 or 75 kg N per feddan whereas, the lower values (35.8 g and 9.6 ardab per fed for previous traits, respectively) were achieved by using the cultivar Sakha 94 when it was fertilized with the 1^{st} dose of 50 kg N per fed (Tables 3, 3-a and 3-b), respectively.

TABLE (3-a). 1000- grain weight per spike of wheat as affected by the interaction between cultivars and nitrogen fertilizer levels, as well as , response equations and predicted maximum 1000- grain weight per spike (Y max) and N level (X max) in the combined data.

Nitrogen fertilizer levels and wheat cultivars	50kg N/fed	75kg N/fed	100kg N/fed	Average	^ Y=a+bx-cx2	X max (NL)	Y max (gm)
Egypt 1	CB 36.11 b	B 36.81 c	A 37.56 bc	36.8	36.11 +0.775X+0.025X2	------	------
Sakha 94	BC 35.8 c	B 36.35 cd	A 37.00 c	36.4	35.8 + 0.7X +0.05X2	------	------
Sids 12	CB 36.65 b	B 37.50 b	A 38.38 b	37.5	36.65 + 0.93X+0.015X2	------	------
Sids 13	C 38.2a	AB 39.00a	A 40.10a	39.1	38.2 + 1.1X+0.15X2	……..	……..
Average	36.7	37.4	38.3				

Analysis according to Sukhatme (1941) as explained by Abdul Galil *et al.* (2003).

$\hat{Y}$= a+bx-cx2, $\hat{Y}_{opt.}$= Y_0 + (b-r)2/4c, (X_{max}) = X_0 + b/2c (u) $X_{opt.}$ = X_0+ b-r/2c (u) Y_{max} =Y_0 +b2/4c

where: Y_0 = 1000- grain weight (gm) per spike at the lowest N level (X_0), *i.e.* 50 kg N /fed. X opt. = optimum N levels (kg/fed.), X max. = maximum N levels (kg/fed.), Y opt. = optimum 1000- grain weight (gm) per spike and Y max = maximum 1000- grain weight (gm) per spike. b = measures the linear components of the response equation. c = measures the quadratic components of the response equation. r =q/p, q = Cost of N unit (u) *i.e.* 50 kg N /fed. = 120.0 L.E. p = price of a unit yield (ardab) = 400 L.E., Ardab=150 kg=0.15 from ton, u= the interval between levels of N, feddan= 0.42 hectare.

TABLE (3-b). Grain yield (ardab per fed) of wheat as affected by the interaction between cultivars and nitrogen fertilizer levels as well as , response equations and predicted maximum and optimum grain yield (ardab per feddan) (Y max and optimum) and N level (X max and optimum) in the combined data.

Nitrogen fertilizer levels and wheat cultivars	50kg N/fed	75kg N/fed	100kg N/fed	Average	^ Y=a+bx-cx2	X max (NL)	Y max (ardab)	X Opt. (NL)	Y Opt. (ardab)
Egypt 1	B 10.7 b	A 10.82 c	A 10.92 c	10.8	10.7 +0.12 X + 0.02X2	…….	……..	…….	……..
Sakha 94	B 9.6 c	A 10.26 d	A 10.53 d	10.1	9.6 +0.54X- 0.045X2	…….	……..	…….	……..
Sids 12	CB 10.73 b	B 11.08b	A 11.30 b	11.1	10.73 +0.5X - 0.1X2	112.5	11.4	75	10.83
Sids 13	B 11.04a	AB 11.65a	A 11.79a	11.5	11.04+0.82X - 0.24X2	93.6	11.8	78.9	11.74
Average	10.5	11.00	11.1						

Analysis according to Sukhatme (1941) as explained by Abdul Galil *et al.* (2003).

$Y^{\wedge} = a+bx-cx2$, $Y^{\wedge}_{opt.} = Y_0 + (b-r)2/4c$, $(X_{max}) = X_0 + b/2c\ (u)$, $X_{opt.} = X_0 + b-r/2c\ (u)$, $Y_{max} = Y_0 + b2/4c$

where: Y_0 =Grain yield at the lowest N level (X_0), *i.e.* 50 kg N per fed .(ardab per feddan).X opt. = optimum N levels (kg per fed.), X max. = maximum N levels (kg per fed.), Y opt. = optimum grain yield (ardab per fed.) and Y max = maximum grain yield (ardab per fed.).b = Measures the linear components of the response equation. c = measures the quadratic components of the response equation. r =q/p, q = Cost of N unit (u) *i.e.*

50 kg N /fed. = 120.0 L.E. p = price of a unit yield (ardab) = 400 L.E., Ardab=150 kg=0.15 from ton, u= the interval between levels of N, feddan= 0.42 hectare.

Conclusion

Wheat cultivars Sids 13 followed by Sids 12 with the highest dose of N (100 kg N per fed.) exceeded those of Egypt 1 and Sakha 94 . This is expected when Sids 13 followed by Sids 12 gave the highest values of spike length (9.66 and 9.66 cm), number of spikelets per spike (16.53 and 15.78), number of grains per spike (39.67 and 39.00), grain weight per spike (2.13 and 2.00 g) 1000-grain weight (39.60 and 38.01 g) as well as grain yield (11.49 and 11.04 ardab per fed for Sids 13 followed by Sids 12 ,respectively) than those receiving 50 or 75 kg N/fed, whereas, the lowest values (8.45 cm,15.45, 37.37, 1.77 g, 36.88 g and 10.13 ardab per fed. for previous traits, respectively) were achieved by planting Sakha 94 and fertilized with the 1st dose of 50 kg N/fed , respectively. The yield could have been maximized to 11.4 and 11.8 ardab per fed due to predicted N addition of 112.5 and 93.6 kg N per fed for Sids 12 followed by Sids 13, respectively. The results , further indicated that, optimum yields were 10.83 and 11.74 ardab per fed could be obtained when 75 and 78.9 kg N per fed were added for Sids 12 followed by Sids 13 in respective order.

References

Abd El-Hmeed, I.M. (2005) Response of two newly released bread wheat cultivars to different nitrogen and phosphorus fertilizer levels. *The 1st Sci. Conf. Cereal Crops*, June 20th, 21st , 2005 (Alexandria).

Abd El-Hmeed, I.M. and Omar, A.E. (2006) Response of bread wheat to some fertilization treatments. *The 31st International Conference for Statistics*, Computer Science and its Applications 1- 6 April .

Abdul Galil, A.A., Basha, H.A., Mowafy, S.A.E. and Ahmed, Seham M.M. (2003) Effect of phosphorus addition on the response of four wheat cultivars to N fertilization level under sandy soil conditions. *Minufiya J. Agric. Res*. **28** (1), 1 – 22.

Ahmed, Seham M.M., Abdul Galil, A.A., Basha, H.A. and Mowafy, S.A.E. (2009) Response of wheat to fertilization under sandy soil conditions. *Zagazig, J. Agric*. *Res.* **36** (4), 1045-1067.

Amin, E.H.M., Ibrahim, A.A., Saleh, M.E. and Ali, A.G.A. (2010) Response of wheat cultivars to varying time of N-application, planting densities and sowing date. *Zagazig, J. Agric. Res*. **37** (4), 803 – 828.

Ashmawy, F. and Abo-Warda, A.M.A. (2002) Response of some wheat cultivars to different seeding rates and nitrogen fertilization levels in sandy soil . *Egypt. J. Appl. Sci.* **17** (10), 136-157.

Duncan, B.D. (1955) Multiple range and multiple F test. *Biometrics*, **11**, 1-42.

El-Murshedy, W.A. (2008) Effect of skipping one irrigation at different developmental stages of five bread wheat cultivars. *J. Agric. Res., Kafer El-Sheikh Univ.* **34** (1), 25-42.

El-Sawi, S.A., Khaled, M.A. and Seleem, S.A. (2006) Effect of splitting fertilization on bread wheat productivity. *J. Agric. Sci., Mansoura Univ.* **31** (10), 6129 – 6142.

FAO (2007) Wheat production prospects," Food Out look' November, Economic and Social Dept.

Gafar, N.A. (2007) Response of some bread wheat varieties grown under different levels of planting density and nitrogen fertilizer. *Minufiya J. Agric. Res.* **32** (1), 165 – 183.

Hassan, A.I., Moselhy, M.M. and Abd El-Mabood, Sh. M. (2002) Evaluation of some wheat cultivars under two levels of irrigation water salinity in calcareous soils, South Sinai . *Zagazig J. Agric. Res.* **29** (1), 1-15.

Mohamed, S.E.A., El-Shewy, A.A. and Mahfouz, H. (2001) Effect of organic and inorganic fertilizers on growth, yield, chemical constituents and anatomical structure of wheat plants *(Triticum aestivum* L.) . *Egypt. J. Appl. Sci.* **16** (4), 124-141.

Ramadan, A.R. and Awaad, S.S. (2008) Response of yield and yield attributes of some bread wheat varieties to irrigation levels and seeding rate under old land conditions. *J. Agric. Sci., Mansoura Univ.* **33** (7), 4717 – 4737.

Saleh, M.E. (2003) Effect of level and splitting nitrogen on the yield potentially of Sids 1 wheat cultivar. *Zagazig J. Agric. Res.* **30** (4), 1169- 1188.

Shaaban, S.M. (2006) Effect of organic and inorganic nitrogen fertilizer on wheat plant under water regime. *Journal of Applied Science Research*, **2** (10), 650 – 656.

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

Steel, R.G.D. and Torrie, J.H. (1980) "*Principles and Procedures of Statistics .A Biometrical Approach"* 2*nd* ed. Mac Graw Hill Book Company, New York .

Sukhatme, P.V. (1941) Economics of manuring. *Indian, J. Agric. Sci*. **9**, 325-337.

Tabl, M.A. , Omar, A.M., El-Sheref, E. and Koriem, M.A. (2005) Effect of seeding rates and nitrogen levels on two wheat cultivars. *Alex. J. Agric. Res.* **50** (2B), 87 – 95.

Weber, E.A., Graff, S., Koller, W.D., Hermann, W., Markt, N. and Claupein, W. (2008) Impact of nitrogen amount and timing on the potential of acrylamide formation in winter wheat (*Triticum aestivum* L.). *Field Crop Research*, **106,** 44 – 52.

Zeidan, E.M., El-Khawaga, A.A., Bashha, H.A. and Abd El-Hameed, I.M. (2005) Improvement of wheat productivity in newly reclaimed soil in Egypt. Annals Universitatis Mariae Curie-Sklodowska Lublin- Polonia, Vol. 1X, Sec. ed. 60, pp. 113-121.

Zeidan, E.M., Abd El- Hameed, I.M., Bassiouny, A.H. and Waly, A.A. (2009) Effect of irrigation intervals, nitrogen and organic fertilization on yield, yield attributes and crude protein content of some wheat cultivars under newly reclaimed saline soil conditions. *4th Conferences on Recent Technologies in Agriculture*, Faculty of Agric., Cairo Univ., Egypt.

(*Received* 5/3/2012;
accepted 10/6/2012)

استجابة أربعة أصناف حديثة لقمح الخبز لمعدلات السماد النيتروجينى تحت نظام الري بالرش بالأراضي الرملية

إسماعيل محمد عبدالحميد
قسم المحاصيل – كلية الزراعة – جامعة الزقازيق – الشرقية – مصر.

اقيمت تجربتان حقليتان خلال موسمى ٢٠١٠/٢٠٠٩ ، ٢٠١١/٢٠١٠ بالمزرعة التجريبية بكلية الزراعة- جامعة الزقازيق بمنطقة الخطارة - بمحافظة الشرقية، لدراسة استجابة بعض أصناف قمح الخبز(مصر ١ – سخا ٩٤ – سدس ١٢ و سدس ١٣) لمعدلات السماد النيتروجينى (٥٠ -٧٥ و١٠٠ كجم ن/فدان) .

ويمكن تلخيص أهم النتائج التى تم التحصل عليهاعلى النحو التالى:

١-اختلفت اصناف قمح الخبز معنويا في جميع الصفات تحت الدراسة حيث تفوق الصنف سدس ١٣ وتلاه الصنف سدس ١٢ ثم الصنف مصر ١ في طول السنبلة وعدد السنيبلات بالسنبلة، عدد حبوب السنبلة، وزن حبوب السنبلة، و محصول الحبوب (بالأردب للفدان)،بينما أعطى الصنف سخا ٩٤ أعلى المتوسطات في ارتفاع النبات واقل القيم لباقي الصفات تحت الدراسة خلال موسمي الدراسة و التحليل المشترك.

٢- أدى إضافة السماد النيتروجينى حتى١٠٠ كجم للفدان إلى زيادة معنوية لجميع الصفات السابق ذكرها. خلال موسمى الدراسة و التحليل المشترك.

٣- أوضحت نتائج التحليل التجميعى للموسمين التأثير المعنوى لتداخل الفعل بين الأصناف ومستويات السماد النيتروجينى على عدد سنيبلات /السنبلة وعدد حبوب السنبلة ، وزن الألف حبة، ومحصول الحبوب وتبين ان استخدام الصنف سدس ١٣ أو سدس ١٢ وبإضافة ١٠٠ كجم نيتروجين للفدان هي أفضل معاملة تم التوصل اليها (التحليل المشترك). أقصى محصول حبوب ١١,٤و ١١,٨ إردب للفدان بإضافة أقصى معدل من السماد النيتروجينى ١١٢,٥ و ٩٣,٦ كجم ن للفدان ، وان امثل محصول ١٠,٨٣ و ١١,٧٤ إردب للفدان بإضافة ٧٥، ٧٨,٩ كجم ن للفدان للصنفين سدس ١٢ وسدس ١٣ على الترتيب.