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Response of Some Bread Wheat Cultivars to Nitrogen Fertilizer Splitting Under Sandy Soil Conditions

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ABSTRACT

The present investigation was carried out at Elwady El Assiuty Experimental Farm, Faculty of Agriculture, Assiut University during 2013/2014 and 2014/2015 seasons to study the effect of nitrogen fertilizer splitting on the productivity of six local bread wheat cultivars under sandy soil condition. Randomized complete block design (RCBD) using strip block arrangement with three replications was used. Cultivars under study viz. Giza-168, Misr-1, Misr-2, Sids-1, Sids-12 and Shandaweel-1 were arranged in horizontal strips, while splitting (3, 4, 5 and 6 times) nitrogen fertilizer treatments were allocated to vertical strips. The obtained results pointed out that the superiority was to Sids-1 cultivar in plant height and spike length in both seasons. Moreover, Sids-12 cultivar surpassed other studied cultivars in spike number m^{-2}, biological and grain yields (ton ha^{-1}) in both seasons. While, Misr-1 cultivar was superior the other studied cultivars in harvest index in both seasons. Here too, Giza-168 and Shandaweel-1 had the highest content of chlorophyll in both seasons. Also, the obtained data showed that 1000 kernel weight (g), biological and grain yields and harvest index increased when nitrogen fertilizer was split into five equal doses in both seasons. The previous findings were true with regard to chlorophyll content in the second season only. The tallest plants were obtained when nitrogen fertilizer was split into six equal doses in the two growing seasons. Moreover, the highest numbers of spikes m^{-2} were recorded when nitrogen fertilizer was split into at three equal doses in both seasons. Also, spike length and spikelets number $spike^{-1}$ were increased when nitrogen fertilizer was split into four equal doses in both seasons. Moreover, the interaction between wheat cultivars and nitrogen fertilizer splitting had a significant influence on all studied traits in both seasons. The highest mean values of chlorophyll content and plant height were recorded from Shandaweel-1 and Sids-1 cultivars, respectively in both seasons when nitrogen fertilizer was split into six equal doses. Finally, the highest grain yield was obtained from Sids-1 cultivar when nitrogen fertilizer was split into five equal doses.
Keywords: Wheat cultivars, Nitrogen fertilizer splitting, Sandy soil

INTRODUCTION

Wheat is the most common cereal crop in Egypt. It is the main source of carbohydrates as well as its contents of proteins. Due to the big gap of wheat production and consumption. There is an aim to cultivate wheat in new reclaimed soils with the best fertilizer applications for high yield.

Nitrogen fertilization development strategies supposed that increase nitrogen use efficiency (NUE) could reduce unnecessary input costs to farmers and environmental impact of N losses. Split application of N fertilizer increased grain weight than single application (Tariq *et al.,* 2007 and Schulz *et al.,* 2015). Ayoub *et al.* (1994) revealed that split N application had little effect on yield, but decreased lodging and spikes population, while grain weight increased. Sahar and Ghadiri (2012) indicated that split application of nitrogen fertilizer showed significant impact on wheat grain and biological yields. Juan *et al.* (2010) pointed out that the use of two or three split N applications increased grain yield and wet gluten content with differences among genotypes and the best N split strategy corresponded to two or three N splits: at planting and tillering; at planting, tillering, and flag leaf, respectively. Ooro *et al.* (2011) revealed that split application of N resulted in superior quality attributes than when the entire N was applied at once. Ahmed *et al.* (2014) reported that splitting of nitrogen fertilizers could be more beneficial than full dose nitrogen at the time of sowing imparting higher yield. Wagan *et al.* (2002) showed that nitrogen applied in three split doses significantly increased plant height, seed index and grain yield as compared to two split applications. Khalid *et al.* (2014) stated that 200 kg N ha^{-1} applied in four equal splits had the highest grain yield, yield components and NUE.

The objectives of this investigation was to study the response of some bread wheat cultivars to nitrogen fertilizer splitting under sandy soil conditions.

MATERIALS AND METHODS

The present investigation was carried out at Assiut University Experimental Farm at Elwady El Assiuty (lat. 27° 16' N, long 31° 34' and alt 53 m *asl*) during 2013/2014 and 2014/2015 seasons to study the effect of nitrogen fertilizer splitting on six local bread wheat cultivars (*Triticum aestivum* L.) *i.e.,* Giza-168, Misr-1, Misr-2, Sids-1, Sids-12 and Shandaweel-1 under sandy soil condition. The mechanical and chemical analyses of the experimental sites of the soil are presented in Table 1.

Randomized complete block design with two factors was used in a strip block arrangement. The experimental unit dimensions were 5 × 5m and the first factor was cultivars which allocated in horizontal strips. The second factor was nitrogen splitting which assigned in vertical strips. The recommended dose of nitrogen (288 kg N ha^{-1}) was split into 3, 4, 5 and 6 times under each cultivar as follows: -

1. S_1 as a three equal splits (96 kg N ha^{-1}) starts 15 days after sowing with 15 days' intervals were applied as nitrogen fertilizer ended after approximately 45 days from sowing.
2. S_2 as four equal splits (72 kg N ha^{-1}) starts 15 days after sowing with 15 days' intervals were applied as

nitrogen fertilizer ended after approximately 60 days from sowing.

3. S_3 as five equal splits (57.6 kg N ha^{-1}) starts 15 days after sowing with 15 days' intervals were applied as nitrogen fertilizer ended after approximately 75 days from sowing.
4. S_4 as six equal splits (48 kg N ha^{-1}) starts 15 days after sowing with 15 days' intervals were applied as nitrogen fertilizer ended after approximately 90 days from sowing.

Table 1. Some physical and chemical properties of experimental sites:

Properties	2013/2014	2014/2015
Mechanical analysis		
Sand	84.4	86.5
Slit	8.7	7.3
Clay	6.9	6.2
Soil type	Sandy	Sandy
Chemical analysis		
Properties	2013/2014	2014/2015
PH	8.34	8.26
Organic matter %	0.097	0.095
Total N%	0.018	0.019
Total CaCO3%	20.26	19.85

Sowing date was done at December 5th and 8th in the first and second seasons, respectively. Drilling sowing method in rows 15 cm apart with a 150 kg ha^{-1} as a seed rate was used. Experiments were will irrigated using sprinkler irrigation system 3 days intervals and all other cultural practices were done according to standard recommendations for sowing wheat in the sandy soil of Upper Egypt.

At the botting stage, ten flag leaf from ten guarded stems in each experimental unite was taken then chlorophyll was measured by chlorophyll meter (SPAD-502, Minolta, Japan) to estimate the SPAD value. At harvest, number of spikes m^{-2} and 1000-kernel weight in gram were recorded from each experimental unit. Then a random sample of ten guarded stems from each experimental unit was taken to estimate plant height in cm, spike length in cm and spikelet number spike^{-1}. Plants of each experimental unit was harvested and converted to ton ha^{-1} for biological and grain yields and harvest index was estimated.

Statistical analysis

The analysis of variance for randomized complete block design (RCBD) with a strip block arrangement was carried out for each studied character in each season according to Gomez and Gomez (1984). Means were compared by revised Least Significant Difference (R LSD) at 5% level of significant (Steel and Torrie, 1981).

RESULTS AND DISCUSSIONS

1- Chlorophyll content (SPAD value)

The results as shown in Table 2 reveal that wheat cultivars exhibited significant ($p \leq 0.05$) differences in chlorophyll content; where, Giza-168 and Shandaweel-1 cultivars were superior significantly to other tested cultivars in both seasons. These results may be due to the genetic variability among the tested cultivars and response of each to the environmental conditions during the growing seasons. Similar results were obtained by Shambhoo *et al.* (2016). Here too, the results reveal that the nitrogen fertilizer splitting exerted a significant influence on chlorophyll content in both seasons where, chlorophyll content increased when S_1 and S_3 were applied. These results may be due to increase nitrogen use efficiently for these applications (Khalid *et al.* 2014). Also, the interaction between cultivars and nitrogen fertilizer splitting point out that a significant influence on chlorophyll content in both seasons. Where, the highest chlorophyll content mean value (52.07) was obtained from Shandaweel-1 cultivar when nitrogen fertilizer was applied at six doses in the first season. While, in the second season the highest mean value (56.17) was obtained from Sids-12 cultivar with five nitrogen equal doses. On the other hand, the lowest mean values (39.37 and 41.77 in the first and second season, respectively) were recorded by Misr-1 cultivar when nitrogen fertilizer was applied at six doses (S_4).

Table 2. Effect of some bread wheat cultivars, splitting nitrogen fertilizer and their interaction on chlorophyll content (SPAD value)

Season	2013/2014					2014/2015				
Splitting Genotypes	S_1	S_2	S_3	S_4	Mean	S_1	S_2	S_3	S_4	Mean
Giza-168	50.40	49.13	48.63	50.80	49.74	51.83	52.20	52.57	53.77	52.59
Misr-1	45.10	47.10	49.90	39.37	45.37	49.90	48.77	53.13	41.77	48.39
Misr-2	45.50	45.33	41.23	45.83	44.47	46.97	48.60	44.07	48.87	47.13
Shandaweel-1	50.23	46.60	49.10	52.07	49.50	53.17	49.23	54.77	53.97	52.78
Sids-1	47.83	43.63	45.60	46.07	45.78	48.83	47.00	52.07	48.07	48.99
Sids-12	47.57	45.83	51.67	47.90	48.24	49.43	48.43	56.17	50.50	51.13
Mean	47.77	46.27	47.69	47.01	47.18	50.02	49.04	52.13	49.49	50.17
	F test		R LSD			F test		R LSD		
Cultivar	*		1.39			*		2.26		
Split	*		0.81			*		1.06		
Cultivar × Split	*		0.80			*		0.74		

Where S_1, S_2, S_3 and S_4 mean nitrogen fertilizer splitting into 3, 4. 5 and 6 equal doses, respectively.
*** : Significant at the 0.05 probability levels. RLSD: Revised least significant differences at 0.05 probability level.**

2- Plant height (cm)

The obtained result in Table 3 show that there were significant variations in plant height among the tested cultivars in both seasons. Thus, Sids-1 cv. produced the tallest plants (84.75 and 87.08 cm in the first and second seasons, respectively) as compared to the others studied cultivars. These results may be due to the genetic variability among the tested cultivars and response of each to the environmental conditions during the growing seasons. These results are agreement with those obtained by Abdelkhalek *et al.* (2015). Also, nitrogen fertilizer splitting exhibited significant influences on plant height in both seasons. The tallest plants (80.78 and 84.78 cm in the first and second season, respectively) were recorded when nitrogen fertilizer was applied for six times (S_4). These results may be due to nitrogen is the nutrient which is not retained in the soil for long time; hence plants can uptake nitrogen during the whole growth period with splitting nitrogen fertilizer. These results are in a good line with those obtained by Wagan *et al.* (2002), Ali (2010) and Amanullah *et al*. (2015). Moreover, the interaction between cultivars and splitting nitrogen fertilizer had a significant influence on plant height in both seasons, where the tallest plants were obtained from Sids-1 when nitrogen fertilizer splitting was applied at S_4 in the two growing seasons.

Table 3. Effect of some bread wheat cultivars, splitting nitrogen fertilizer and their interaction on plant height (cm)

Season	2013/2014					2014/2015				
Splitting Genotypes	S_1	S_2	S_3	S_4	Mean	S_1	S_2	S_3	S_4	Mean
Giza-168	72.67	78.00	76.00	76.33	75.75	74.67	81.00	78.33	81.00	78.75
Misr-1	80.33	70.00	70.33	80.00	75.17	81.33	72.00	74.67	84.00	78.00
Misr-2	75.67	80.00	78.33	80.33	78.58	84.67	84.33	82.33	83.33	83.67
Shandaweel-1	76.67	75.67	86.00	76.00	78.58	79.67	76.33	88.67	79.67	81.08
Sids-1	81.00	84.00	82.67	91.33	84.75	84.33	85.00	84.67	94.33	87.08
Sids-12	76.67	82.67	76.67	80.67	79.17	79.67	85.67	79.00	86.33	82.67
Mean	77.17	78.39	78.33	80.78	78.67	80.72	80.72	81.28	84.78	81.88
	F test			R LSD		F test			R LSD	
Cultivar	*			1.20		*			2.47	
Split	*			0.58		*			0.76	
Cultivar × Split	*			0.40		*			0.79	

***: Significant at the 0.05 probability levels.**
RLSD: Revised least significant differences at 0.05 probability level.

3- Spike length (cm)

Concerning spike length trait, results in Table 4 show that there were significant variations among the tested cultivars in the second season, only. However, Sids-1 gained the highest mean values of spike length (9.08 and 10.25 cm in the first and second season, respectively) as compared to the others studied cultivars. These results may be due to the genetic variability among the tested cultivars and response of each to the environmental conditions during the growing seasons. These results are agreement with those obtained by Noureldin *et al.* (2013), Samadiyan *et al.* (2013) and Abdelkhalek *et al.* (2015). Furthermore, nitrogen fertilizer splitting gave a significant influence on spike length in the first season, only. The highest mean values of spike length (9.03 cm) were recorded when nitrogen fertilizer was split into four times (S_2). Here too, wheat cultivars and nitrogen fertilizer splitting interaction had a significant effect on spike length in both seasons, where the tallest spikes (10.17 and 11.17 cm in the two seasons, respectively) were obtained from Sids-1 when nitrogen fertilizer was split into four times (S_2). While, the shortest spikes (7.67 cm) were recorded from Misr-1 with S_3 or Sids-1 with S_4 in the first season, being 8.67 cm from Misr-1 with S_3 treatment in the second season

Table 4. Effect of some bread wheat cultivars, splitting nitrogen fertilizer and their interaction on spike length (cm)

Season	2013/2014					2014/2015				
Splitting Genotypes	S_1	S_2	S_3	S_4	Mean	S_1	S_2	S_3	S_4	Mean
Giza-168	8.83	8.83	9.67	8.83	9.04	10.00	10.17	10.67	9.33	10.04
Misr-1	9.17	8.17	7.67	7.83	8.21	9.83	9.00	8.67	8.83	9.08
Misr-2	8.67	9.17	8.50	8.83	8.79	9.67	9.67	9.33	10.00	9.67
Shandaweel-1	8.00	9.17	9.83	8.67	8.92	8.83	10.67	11.00	10.17	10.17
Sids-1	9.50	10.17	9.00	7.67	9.08	10.50	11.17	9.83	9.50	10.25
Sids-12	8.50	8.67	9.17	7.83	8.54	9.33	9.83	9.67	9.33	9.54
Mean	8.78	9.03	8.97	8.28	8.76	9.69	10.08	9.86	9.53	9.79
	F test			R LSD		F test			R LSD	
Cultivar	NS			---		*			0.70	
Split	*			0.29		NS			---	
Cultivar × Split	*			0.24		*			0.21	

NS and *: Not significant and Significant at the 0.05 probability levels, respectively.
RLSD: Revised least significant differences at 0.05 probability level.

4- 1000 kernel weight (g)

Data illustrated in Table 5 focus that 1000 kernel weight was significant differences among the studied cultivars in both seasons, where, Sids-1 had the heaviest mean value (27.59 g) in the first season. While, Masr-1 cultivar surpassed all other tested cultivar in the second season (32.69 g). The disparity in seed index among studded wheat cultivars might be due to the genetic makeup reflecting on grain filling rate and translocation of biochemical assimilates from source to sink. These results are agreement with those obtained by Noureldin *et al.* (2013). Moreover, nitrogen fertilizer splitting had a significant effect on the seed index in the two growing seasons. Seed index was increased linearly with increase of splitting numbers up to S_3 where, the highest seed index (26.53 and 29.75 g in the first and second season, respectively) were obtained from S_3 treatment. These results are in a good line with those obtained by Amanullah *et al*. (2015). Furthermore, seed index was responded significantly to the interaction between wheat cultivars and nitrogen fertilizer splitting in both seasons. The highest mean values (33.76 and 35.64 g in the first and second season, respectively) were obtained from Sids-1 and Misr-2 with S_3 treatment (split nitrogen fertilizer into five doses).

Table 5. Effect of some bread wheat cultivars, splitting nitrogen fertilizer and their interaction on 1000-kernel weight (g)

Season	2013/2014					2014/2015				
Splitting Genotypes	S_1	S_2	S_3	S_4	Mean	S_1	S_2	S_3	S_4	Mean
Giza-168	16.34	22.06	25.41	30.50	23.58	17.33	28.02	28.07	34.31	26.93
Misr-1	24.96	29.01	28.62	24.19	26.69	32.81	35.24	31.14	31.58	32.69
Misr-2	14.98	30.27	28.80	22.17	24.05	24.30	32.94	35.64	26.03	29.73
Shandaweel-1	19.49	22.26	21.50	16.52	19.94	26.57	24.82	26.77	21.63	24.95
Sids-1	22.49	25.72	33.76	28.40	27.59	25.84	27.74	35.22	31.54	30.09
Sids-12	14.34	25.77	21.11	21.07	20.57	19.43	27.21	21.68	27.70	24.01
Mean	18.77	25.85	26.53	23.81	23.74	24.38	29.33	29.75	28.80	28.07
	F test		R LSD			F test		R LSD		
Cultivar	*		2.32			*		2.69		
Split	*		1.05			*		1.08		
Cultivar × Split	*		1.21			*		1.06		

***: Significant at the 0.05 probability levels.**
RLSD: Revised least significant differences at 0.05 probability level.

5- Spikelets number spike^{-1}

Presented data in Table 6 reveal that studied wheat cultivars did not exhibit any significant differences in spikelets number spike^{-1} in both seasons. Also, it is clear that nitrogen fertilizer splitting exerted a significant effect on number of spikelets spike^{-1} in the second season only. Thus, nitrogen fertilizer splitting four equal doses (S_2) had the highest mean value (17.89 spikelets spike^{-1}) while, S_4 treatment produced the lowest one (17.11 spikelets spike^{-1}). These results confirmed with those obtained by Amanullah *et al.* (2015). Also, the interaction between wheat cultivars and nitrogen fertilizer exerted splitting had significant influences on spikelets number spike^{-1} in both seasons. The highest mean value of spikelets number spike^{-1} (18.33) was obtained from Shandaweel-1 when nitrogen fertilizer splitting at S_3 was applied, in the first season. But, in the second season the highest mean value (19.67 spikelets spike^{-1}) was obtained from Misr-1 with S_2.

Table 6. Effect of some bread wheat cultivars, splitting nitrogen fertilizer and their interaction on Spikelet number spike^{-1}

Season	2013/2014					2014/2015				
Splitting Genotypes	S_1	S_2	S_3	S_4	Mean	S_1	S_2	S_3	S_4	Mean
Giza-168	16.33	16.33	17.00	16.33	16.50	17.67	17.67	18.33	17.00	17.67
Misr-1	16.33	17.67	16.33	16.33	16.67	17.00	19.67	18.33	17.00	18.00
Misr-2	16.33	15.00	17.00	15.67	16.00	17.00	15.67	17.00	17.00	16.67
Shandaweel-1	16.33	16.33	18.33	16.33	16.83	17.00	18.33	19.00	17.00	17.83
Sids-1	17.00	17.00	15.00	15.00	16.00	17.00	19.00	15.00	17.00	17.00
Sids-12	16.33	16.33	15.00	15.67	15.83	18.33	17.00	17.00	17.67	17.50
Mean	16.44	16.44	16.44	15.89	16.31	17.33	17.89	17.44	17.11	17.44
	F test		R LSD			F test		R LSD		
Cultivar	NS		---			NS		---		
Split	NS		---			*		0.47		
Cultivar × Split	*		1.29			*		0.62		

NS,*: Not significant and Significant at the 0.05 probability levels, respectively.
RLSD: Revised least significant differences at 0.05 probability level.

6- Number of spikes m^{-2}

Data exhibited in Table 7 show significant differences between wheat cultivars in number of spikes m^{-2} in both seasons. Thus, Sids-12 cultivar gave the highest mean values of spikes number m^{-2} (314.32 and 355.24, in the first and second seasons, respectively). These results may be due to the genetic variability among the tested cultivars and response of each to the environmental conditions during the growing seasons. These results are in harmony with those obtained by Noureldin *et al.* (2013) and Abdelkhalek *et al.* (2015).

Nitrogen splitting application had a significant effect on number of spikes m^{-2} in the two growing seasons. Nitrogen fertilizer splitting into three equal doses registered the highest mean values of spikes number m^{-2} (300.68 and 353.19 spike m^{-2} in the two seasons, respectively) as compared to the others studied treatments. Similar results were obtained by Amanullah, *et al*. (2015). Also, the present data revel that the interaction between wheat cultivars with splitting nitrogen fertilizer had a significant effect on number of spikes m^{-2} in the two growing seasons. The highest mean values of spikes number m^{-2} (341.33 and 415.11 spikes m^{-2} in the first and second seasons respectively) were obtained from Giza-168 cultivar with S_3 and S_5 in the first and second seasons, respectively.

Table 7. Effect of some bread wheat cultivars, splitting nitrogen fertilizer and their interaction on spikes number m^{-2}

Season	2013/2014					2014/2015				
Splitting Genotypes	S_1	S_2	S_3	S_4	Mean	S_1	S_2	S_3	S_4	Mean
Giza-168	341.33	270.67	328.44	227.11	291.89	356.44	298.67	415.11	300.89	342.78
Misr-1	234.22	179.56	235.56	225.33	218.67	326.67	232.89	285.78	317.78	290.78
Misr-2	292.44	250.67	266.67	210.22	255.00	345.33	257.33	311.56	240.44	288.67
Shandaweel-1	317.33	301.48	280.89	217.33	279.26	358.67	328.15	337.78	234.67	314.81
Sids-1	293.78	242.67	305.33	300.44	285.56	342.22	287.56	328.44	310.81	317.26
Sids-12	324.89	326.22	327.11	279.11	314.33	389.78	339.11	368.00	324.00	355.22
Mean	300.67	261.88	290.67	243.26	274.12	353.19	290.62	341.11	288.10	318.25
	F test		R LSD			F test		R LSD		
Cultivar	*		29.62			*		36.72		
Split	*		14.59			*		5.03		
Cultivar × Split	*		19.54			*		10.15		

***: Significant at the 0.05 probability levels.**
RLSD: Revised least significant differences at 0.05 probability level.

7- Biological yield (ton ha^{-1})

Exhibited data in Table 8 clear that the studied cultivars had a significant effect on biological yield in both seasons. Thus, Sids-12 cultivar surpassed the others studied cultivars in this respect and produce the highest mean values of biological yield, which about 14.14 and 12.82 ton ha^{-1} in the first and second seasons, respectively. This is to be expected since the same cultivar produced the highest number of spikes m^{-2} and consequently produced the highest mean values of biological yield ton ha^{-1}. These results are in the same trend with those obtained by Noureldin *et al.* (2013) and Abdelkhalek *et al.* (2015). On the other hand, the obtained results show a significant effect of nitrogen splitting on biological yield in the second season only. Thus, Splits nitrogen fertilization to five equal doses resulted in maximum biological yield (11.34 ton ha^{-1}). This is logic since the same splitting doses produced the highest mean values of most studied traits as shown before and consequently produced the highest biological yield. These results are in agreement with those obtained by Sahar and Ghadiri (2012) and Amanullah *et al*. (2015). Also, the interaction between wheat cultivars and splitting nitrogen had a significant effect on biological yield in the two growing seasons. The highest mean value of biological yield (16.17 ton ha^{-1}) was obtained from Sids-1 with S_4 treatment in the first season, while, in the second season the highest mean value was obtained from Sids-12with S_4(13.68 ton ha^{-1}).

Table 8. Effect of some bread wheat cultivars, splitting nitrogen fertilizer and their interaction on biological yield (ton ha^{-1})

Season	2013/2014					2014/2015				
Splitting Genotypes	S_1	S_2	S_3	S_4	Mean	S_1	S_2	S_3	S_4	Mean
Giza-168	11.73	15.21	12.52	11.67	12.78	9.63	9.81	12.26	10.49	10.55
Misr-1	10.45	9.28	9.94	12.97	10.66	10.82	7.71	8.75	11.39	9.67
Misr-2	14.28	12.61	11.60	13.73	13.05	10.69	9.66	11.92	10.36	10.66
Shandaweel-1	11.92	10.51	14.14	11.35	11.98	11.39	7.17	11.54	7.29	9.35
Sids-1	11.69	11.36	13.56	16.17	13.20	9.58	9.64	11.94	13.13	11.07
Sids-12	14.04	14.69	13.41	14.40	14.14	13.41	12.53	11.64	13.68	12.82
Mean	12.35	12.28	12.53	13.38	12.64	10.92	9.42	11.34	11.06	10.68
	F test		R LSD			F test		R LSD		
Cultivar	*		1.71			*		1.19		
Split	NS		---			*		0.43		
Cultivar × Split	*		0.93			*		0.73		

NS and*: Not significant and Significant at the 0.05 probability levels, respectively.
RLSD: Revised least significant differences at 0.05 probability level.

8- Grain yield (ton ha^{-1})

Illustrated data in Table 9 exhibited significant differences between studied cultivars with regard to grain yield in both seasons. In this respect, Sids-12 cultivar show superiority in grain yield in both seasons as compared to the rest cultivars. This is to be expected since the same cultivar gained the highest mean values of biological yield and consequently produced the highest grain yield. These results are in harmony with those obtained by Burhan (2010) and Noureldin *et al.* (2013). Moreover, grain yield (ton ha^{-1}) was significantly affected by nitrogen splitting application. The highest mean values of grain yield (4.35 and 3.99 ton ha^{-1} in the first and second season, respectively) were obtained from S_3 nitrogen fertilizer splitting. These results are in accordance to those obtained by Sahar and Ghadiri (2012) and Amanullah, *et al*. (2015). Also, the interaction between cultivars and nitrogen splitting application had a significant effect on grain yield (ton ha^{-1}.) where, the highest mean values of grain yield (5.36 and 5.00 ton ha^{-1} in the first and second seasons, respectively) were obtained from Sids-1cultivar subjected to five doses of nitrogen splitting.

Table 9. Effect of some bread wheat cultivars, splitting nitrogen fertilizer and their interaction on grain yield (ton ha^{-1})

Season	2013/2014					2014/2015				
Splitting Genotypes	S_1	S_2	S_3	S_4	Mean	S_1	S_2	S_3	S_4	Mean
Giza-168	3.17	3.57	5.00	3.96	3.92	2.86	2.86	4.64	3.93	3.57
Misr-1	4.23	3.81	3.26	3.98	3.82	4.28	3.21	2.86	3.57	3.48
Misr-2	4.30	3.91	4.02	2.50	3.68	3.57	3.21	3.93	2.14	3.21
Shandaweel-1	4.03	3.49	4.14	2.86	3.63	3.93	2.50	3.57	2.14	3.03
Sids-1	3.86	3.66	5.36	4.43	4.33	3.21	2.86	5.00	3.93	3.75
Sids-12	3.94	5.07	4.34	4.99	4.58	3.57	4.28	3.93	4.64	4.11
Mean	3.92	3.92	4.35	3.78	3.99	3.57	3.15	3.99	3.39	3.53
	F test			R LSD		F test			R LSD	
Cultivar	*			0.21		*			0.22	
Split	*			0.18		*			0.17	
Cultivar × Split	*			0.17		*			0.13	

***: Significant at the 0.05 probability levels.**
RLSD: Revised least significant differences at 0.05 probability level.

9- Harvest index

Wheat cultivars exhibited significant differences in harvest index in both seasons (Table 10). In this respect, Misr-1 cultivar showed superiority in harvest index in both seasons as compared to others studied cultivars. This is to be expected since the same cultivar gained the lowest mean value of biological yield and ordinary mean value of grain yield and consequently produced the highest mean value of harvest index. Here too, harvest index was significantly affected by nitrogen splitting application in both seasons. The highest mean values of harvest index (34.76 and 35.19% in the first and second seasons, respectively) were obtained when nitrogen fertilizer were applied at five equal doses. These results are in agreement with those obtained by Amanullah, *et al*. (2015). Furthermore, the obtained results (Table 10) highlight that the interaction between cultivars and nitrogen splitting had a significant effect on harvest index where, the highest mean value of harvest index (41.04 % in the first season) was obtained from Misr-1 cultivar when nitrogen splitting application was applied at four equal doses, but in the second season the highest mean value (41.82%) was registered from Sids-1 cultivar when nitrogen splitting application was applied at five equal doses.

Table 10. Effect of some bread wheat cultivars, splitting nitrogen fertilizer and their interaction on harvest index

Season	2013/2014					2014/2015				
Splitting Genotypes	S_1	S_2	S_3	S_4	Mean	S_1	S_2	S_3	S_4	Mean
Giza-168	27.03	24.22	39.98	33.96	31.30	29.67	29.08	37.97	37.40	33.53
Misr-1	40.47	41.04	32.91	30.70	36.28	39.66	41.68	32.65	31.35	36.34
Misr-2	30.66	31.09	34.57	18.73	28.76	33.38	33.28	34.04	21.42	30.53
Shandaweel-1	33.75	33.20	29.24	25.16	30.34	34.51	34.83	30.90	29.40	32.41
Sids-1	33.05	32.33	39.60	27.37	33.09	33.56	29.69	41.82	29.88	33.74
Sids-12	28.10	34.48	32.24	34.65	32.37	26.62	34.18	33.75	33.96	32.13
Mean	32.18	32.73	34.76	28.43	32.02	32.90	33.79	35.19	30.57	33.11
	F test			R LSD		F test			R LSD	
Cultivar	*			2.86		*			2.36	
Split	*			1.83		*			0.58	
Cultivar × Split	*			1.36		*			1.66	

***: Significant at the 0.05 probability levels.**
RLSD: Revised least significant differences at 0.05 probability level.

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استجابة بعض أصناف قمح الخبز لتجزئة السماد النيتروجيني تحت ظروف التربة الرملية

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أجريت الدراسة الحالية في المزرعة الارشاديه بالوادي الأسيوطي التابعة لكلية الزراعة، جامعة أسيوط خلال الموسمين الزراعيين ٢٠١٤/٢٠١٣ و٢٠١٥/٢٠١٤ لدراسة تأثير تجزئة التسميد النيتروجيني على إنتاجية ستة أصناف محليه من قمح الخبز تحت ظروف التربة الرملية. ولتنفيذ هذه التجربة تم استخدام تصميم القطاعات الكاملة العشوائيه تحت ترتيب القطاعات المنشقة في ثلاثة مكررات. حيث تم وضع الأصناف (جيزة ١٦٨، مصر ١، مصر ٢، سدس ١، سدس ١٢ وشندويل ١) في الاتجاه الافقى، في حين تم تخصيص الاتجاه الراسى لتجزئة السماد النيتروجيني (٣ و ٤ و ٥ و ٦ مرات). أشارت النتائج التي تم التوصل اليها إلى تفوق الصنف سدس ١ في صفتي ارتفاع النبات وطول السنبله (سم) في كلا الموسمين، بينما أظهر الصنف سدس ١٢ تفوقا علي كل الأصناف محل الدراسة في صفات عدد السنابل في المتر المربع والمحصول البيولوجي ومحصول الحبوب بالطن للهكتار في كلا الموسمين. علي الجانب الآخر أظهر الصنف مصر ١ تفوقاً علي باقي الأصناف في صفة دليل الحصاد في كلا الموسمين. بينما تحصل علي أعلى محتوى كلوروفيل في الموسمين الأول والثاني من صنفي جيزة ١٦٨ وشندويل ١ على التوالي. اما بالنسبة لتجزئة السماد النيتروجيني فقد أظهرت النتائج انه تم الحصول على اعلي قيمة من معامل الحبوب والمحصول البيولوجي ومحصول الحبوب عند تجزئة السماد النيتروجيني إلى خمس جرعات متساوية في كلا الموسمين. وقد تم الحصول على أقصي ارتفاع للنبات عند تجزئة السماد النيتروجيني الي ست جرعات متساوية خلال موسمي الزراعة. علي الجانب الاخر تم الحصول علي اعلي عدد من السنابل في المترالمربع عند تجزئة السماد النيتروجيني الي ثلاث جرعات متساوية خلال موسمي الزراعة. بينما زاد طول السنبلة وعدد السنابل في المتر المربع عندما قسم السماد النيتروجيني الي أربع جرعات متساوية في كلا الموسمين. وعلاوة على ذلك، كان التفاعل بين أصناف القمح وتجزئة السماد النيتروجيني ذا تأثير معنوي على جميع الصفات المدروسة في كلا الموسمين. حيث سجلت أعلى قيم لمتوسطات صفات محتوى النبات من الكلوروفيل وارتفاع النبات من تفاعل صنفي شندويل ١ وسدس ١ مع تجزئة السماد النيتروجينى إلى ست جرعات متساوية على التوالي في كلا الموسمين. وأخيرا سجل التفاعل بين صنف سدس ١ مع خمس جرعات متساويه من التسميد النيتروجيني أعلي محصول حبوب خلال موسمي الزراعة.