

EFFECT OF SEEDING RATES ON YIELD AND YIELD COMPONENTS OF TWO BREAD WHEAT CULTIVARS

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ABSTRACT

Two field experiment were conducted in 2012/13 and 2013/14 growing seasons at Faculty of Agricultural– Kafrelsheikh University to study the effect of four seeding rates on yield and yield components of two bread wheat cultivars. This study was laid out in a split plot design with three replications. Wheat cultivars, Sids 12 and Misr 1 were allocated in the main plots. The four seeding rates, 200, 250, 300 and 350 seeds/m² were randomly assigned in the sub plots. The studied trait were: days to heading, days to maturity, grain filling period, grain filling rate, plant height, flag leaf area, number of spikes/m², 1000 -kernel weight, number of kernels/spike, grain yield, straw yield and harvest index. The results indicated that Misr 1 recorded the highest values for days to heading and maturity, grain filling rate, plant height, number of spikes/m² and straw yield. Meanwhile Sids 12 had recorded the highest values for 1000-kernel weight and harvest index. Lower seeding rates increased number of days to heading and maturity, flag leaf area, 1000-kernel weight, number of kernels/spike and harvest index. Increases of seeding rate increased plant height, number of spikes/m², grain and straw yields.

Differences due to interaction between seeding rates and cultivars were significant for number of days to heading in 2013/14 and highly significant for plant height and number of spikes/m², and significant for grain yield, straw yield and harvest index in 2012/13 growing season.

Misr 1 recorded the highest values for number of days to heading with 200 seeds/m², and the tallest plant with 350 seeds/m², also both Sids 12 and Misr 1 recorded the highest number of spikes/m² and grain yield with 350 seeds/m². Misr 1 produced the higher straw yield of 350 seeds/m². Misr 1 recorded the highest harvest index with 200 seeds/m² without significant different with Sids 12 at 350 seeds/m².

Key word: *Wheat, seeding rate, cultivars, yield and yield components, and heading date.*

INTRODUCTION

Wheat is the main winter cereal crop in Egypt. The production is not sufficient to meet the consumption. Therefore, developing high yielding varieties as well as improving cultural practices is necessary to solve this problem. Management practices play an important role in determining the yield and are essential to enhance wheat production and reduce importing. Wheat is grown in a wide range of environments that affect overall performance, particularly grain yield. Climatic factors

over which producers have little control (such as precipitation, temperature, day length), soil types, and management practices (such as fertilizer, herbicides, fungicides, irrigation, time of sowing, and seeding rate) some of which may partially mitigate other environmental factors.

The differences among wheat cultivars were recorded by most researchers, e.g. Gafaar (2007), Hafez (2007), Hammad and Abdel Aty (2007) and Amin *et al.* (2010). These differences due to genetic background or the interaction with environmental conditions. Previous research's studies have shown different effects of seeding rate on the yield and its components in wheat. Mosalem (1993), Toaima *et al.* (2000), Allam (2005), El Hag (2006), El Hag-Dalia (2008), Ramadan and Awaad (2008), Baloch *et al.* (2010) and Kiliç and Gürsoy (2010) reported that increasing seed rate increased plant height, number of spikes/unit area, grain and straw yields, while it decreased kernels/spike and 1000- kernel weight. Meysam and **Saeedipour** (2015) reported that the seed rate significantly influenced different variables that included; spikes/m², number of grains/spike, 1000 kernel weight, grain yield, biological yield and harvest index. Increased seeding rate was able to increase grain yield and number spikes/m². However, 1000-grain weight was decreased with increasing seeding rate.

Numerous studies have documented how seeding rate, planting date, row spacing, and seeding depth affect yield and yield components of wheat. Although the effect of seeding rate on agronomic performance of cultivars is been studied since 1926. The effect of seeding rate on the overall performance of recently released, high-yielding cultivars is unknown. Thus, it is important to evaluate the effect of seeding rate on agronomic performance of recently released cultivars. The objectives of this study were to evaluate the influence of seeding rate on agronomic performance of the two Egyptian bread wheat cultivars Misr 1 and Sids 12.

MATERIALS AND METHODS

Cultivars and Experimental Sites:-

Two field experiments were conducted in 2012/13 and 2013/14 growing seasons at Faculty of Agriculture, Kafrelsheikh University to study the effect of four seeding rates on two bread wheat cultivars. Soil of the experimental site is classified as clay textured (Table 1). The field was prepared with standard production practices, such as land preparation, fertilizer application, herbicide application. Each-year the experiment was conducted as a randomized complete block design with three replications using a split plot treatment arrangement. The cultivars Sids 12 and Misr 1 (Table 2) were randomly allocated in the

main plots and seed rate (four seeding rates were 200, 250, 300 and 350 seeds/m²) randomly arranged in the sub-plots. The sub-plot area was 4.2 m² (6 rows x 20 cm apart x 3.5 m long). The data collected were: Days to heading, days to maturity, grain filling period (day), grain filling rate (kg/day/fed.), plant height (cm), flag leaf area (cm²), number of spikes/m², 1000 kernel weight (g), number of kernels /spike, grain yield (t/fed.), straw yield (t/fed.) and harvest index (%).

Table 1: Some physical and chemical properties of the experiment soil before sowing

Season	2012-2013	2013-2014
Mechanical analysis		
Sand	16.3	14.0
Silt	38.5	35.4
Clay	45.2	51.6
Texture	clay	Clay
Available (ppm)		
N	42.7	56.2
P	10.5	16.13
K	287.1	325.7

Table 2: Name and pedigree of wheat genotypes used in this investigation

Genotype	Pedigree
Sids 12	BUC//7C/ALD/5/MAYA74/ON//1160.147/3/BB/GLL/4/CHAT" S"/6/MAYA/VUL//CMH74A.630/4*SX. SD7096-4SD-1SD-1SD-0SD.
Misr 1	OASIS/SKAUZA//4*BCN/3/2*PASTOR CMSSOOYO1881T-OSOM-30Y-030M-030WGY-33M-OY- OS

Statistical analysis:

Data collected for the two seasons were subjected to analysis of variance and means of treatment effects were compared using Duncan's Multiple Range Test (Duncan,1955). All statistical analysis was performed using analysis of variance technique by "MSTAT-C" computer software package.

RESULTS AND DISCUSSION

Analysis of variance :-

Analysis of variance of earliness and yield and it's components are presented in Table 3.

Table 3: Estimated mean squares of earliness characters and yield components and yield for cultivars and seeding rate and their interaction in 2012/13 and 2013/14 seasons

S.O.V.	D.F.	heading date		Maturity date		Grain filling period	
		2012/13	2013/14	2012/13	2013/14	2012/13	2013/14
year							
Rep.	2	0.292	0.875*	0.08	1.292	0.042	1.167
Cultivar	1	24.00*	70.042**	9.375*	28.16*	3.375	9.375
Error 1	2	0.373	0.042	0.373	1.292	1.125	1.5
Seed rate	3	12.944**	7.375**	12.486**	8.944**	0.153	0.819
c x s	3	0.778	1.153**	0.153	0.5	1.375	2.375
Error 2	12	3.333	0.347	0.236	0.514	0.472	0.722
S.O.V.	D.F.	Grain filling rate		plant height		flag leaf area	
year		2012/13	2013/14	2012/13	2013/14	2012/13	2013/14
Rep.	2	4.663	106.719	7.719	209.375*	1.127	0.335
cultivar	1	189.7*	767.49	283059*	301.042*	17.34	10.938
Error 1	2	9.509	103.511	8.094	7.292	7.865	6.135
Seed rate	3	197.2**	254.724*	25.288**	14.931*	82.788**	83.891**
c x s	3	48.101	34.22	12.038**	3.819	2.648	0.779
Error 2	12	19.721	55.039	1.684	4.167	1.402	0.502
S.O.V.	D.F.	Tillers/m2		1000 -kw		kernel/spike	
year		2012/13	2013/14	2012/13	2013/14	2012/13	2013/14
Rep.	2	36.292	764.85	0.338	2.042	1.167	5.542
cultivar	1	1666.6*	7783.2*	7.594	24.00**	9.375	7.042
Error 1	2	75.54	427.92	5.566	0.875	1.55	7.542
Seed rate	3	3763.2**	809.95	21.585**	10.889**	21.264**	27.264**
c x s	3	324.11**	419.357	2.258	0.444	0.708	1.597
Error 2	12	34.58	260.96	1.903	0.625	2.111	0.764
S.O.V.	D.F.	Grain yield		Straw yield		Harvest index %	
year		2012/13	2013/14	2012/13	2013/14	2012/13	2013/14
Rep.	2	0.009	0.146	0.166	0.768	4.919	12.301
cultivar	1	0.064	0.552	2.413*	5.568*	23.094*	69.017
Error 1	2	0.005	0.076	0.035	0.101	0.682	13.519
Seed rate	3	0.205**	0.312*	1.277**	1.450*	7.148	10.376
c x s	3	0.077*	0.02	0.265	0.037	15.53*	2.821
Error 2	12	0.018	0.073	0.082	0.339	3.273	7.401

Earliness measures:

Data presented in Table 4 indicated that the differences were significant and highly significant for days to heading, significant for days to maturity and insignificant for grain filling period. Also, data in Table 6 showed significant difference in grain filling rate in the first season, significant differences on plant height in both seasons and insignificant differences on flag leaf area in both seasons between the two cultivars respectively. Sids 12 was earlier than Misr 1 cultivar needing less number of days to heading and days to maturity in both seasons. Generally, Sids 12 recorded the low attributed to their variation in genetic make-up and to the unsteady environmental condition (Shehab El-Din 1993), Geleta *et al.*(2002), El Hag (2006) and Soomro *et al.* (2009).

The data presented in Table 4 indicated that seeding rate had highly significant effect on number of days to heading, days to maturity and insignificant on grain filling period in both seasons. Increasing seeding rates decreased the number of days to heading and to maturity. An increase in seeding rate resulted in regularly more main stem, which normally flower earlier than do the secondary tillers. The greater, the proportion of main stem in the plot, the earlier the plot

appeared to be. This results was in agreement with the finding from reduced seeding rates may also be the cause of variable and delayed maturation (Thompson *et al.* 1993) which in term resulted in the crop being uneven and more difficult to manage and harvest.

The interaction effect among cultivars and seeding rates was significant in the second season for days to heading Table 5. Misr 1 recorded 100 days to heading with sowing rates 200 seed/m², Meanwhile Sids 12 recorded 94 days under 350 seeds/m².

Table 4: Mean values of number of days to 50% of heading and maturity, grain-filling period as affected by cultivars, seeding rates and their interactions in 2012/13 and 2013/14 growing seasons

Treatment	Number of days to heading (days)		Number of days to maturity (days)		Grain filling period (Days)	
	2012/13	2013/14	2012/13	2013/14	2012/13	2013/14
Cultivars (C):-						
Sids12	103.9b	95.9b	142.8b	140.8b	38.9	44.9
Misr1	105.9a	99.3a	144.1a	143.0a	38.2	43.7
F test	*	**	*	*	NS	NS
Seed rate (Seed/m ²) S:-						
200	106.5a	99.0a	145.2a	143.2a	38.7	44.2
250	105.7b	98.0b	144.0b	142.5ab	38.3	44.5
300	104.3c	97.0c	142.8c	141.7b	38.5	44.7
350	103.2d	96.5c	141.8d	140.3c	38.7	43.8
F test	**	**	**	**	NS	NS
Interaction:-						
C x S	NS	*	NS	NS	NS	NS

Means designated by the same letter are not significantly different at 5 % level according to Duncan' s Multiple Range Test.

Table 5: Mean of number of days to heading in 2013/14, Plant height in 2012/13 and number of fertile tillers in 2012/13 as affected by the interaction between cultivar and seeding rate

Treatment	Number of days to heading (days)		Plant height (cm)		Number of fertile tillers/m ²	
	Sids 12	Misr 1	Sids 12	Misr 1	Sids 12	Misr 1
	2013/14		2012/13		2012/13	
Seed rate (Seed/m ²) S:-						
200	98c	100a	114e	124b	351d	385c
250	97d	99 b	117d	125a	380c	400c
300	95e	99b	120c	126a	401b	417a
350	94e	99b	122c	126a	427a	425a
F test	*		**		**	

Means designated by the same letter are not significantly different at 5 % level according to Duncan' s Multiple Range Test.

Data presented in Table 6 indicated significant difference between the two cultivars in grain filling rate in the first season,

significant differences on plant height in both seasons and insignificant differences on flag leaf area in both seasons. Generally, Sids 12 recorded the lowest values in grain filling rate and plant height as compared with Misr 1. Regarding seeding rate the data in Table 6 indicated highly significant and significant effect on grain filling rate and highly significant and significant on plant height and highly significant on flag leaf area in both seasons, respectively. Increasing seed rate increased positively grain filling rate and plant height and decreased flag leaf area.

Table 6: Mean of grain filling rate, plant height and flag leaf area as affect by cultivars, seeding rate (seeds/m²) and their interaction in 2012/13 and 2013/14 growing seasons

Treatment	Grain filling rate (kg/day/fed.)		plant height (cm)		flag leaf area (cm ²)	
	2012/13	2013/14	2012/13	2013/14	2012/13	2013/14
Cultivars (C):-						
Sids12	118.47b	97.59	118.4b	109.6b	33.8	32.4
Misr1	124.10a	108.99	125.3a	116.7a	35.5	33.8
F test	*	NS	*	*	NS	NS
Seed rate (Seed/m ²) S:-						
200	114.00c	96.49c	118.9b	110.8b	38.9a	37.6a
250	120.05b	99.31bc	121.8a	113.3ab	36.3b	34.2b
300	123.58ab	106.47ab	123.0a	114.2a	32.8c	31.7c
350	127.51a	110.72a	123.5a	114.2a	30.5d	28.8d
F test	**	*	**	*	**	**
Interaction: -						
C x S	NS	NS	**	NS	NS	NS

Means designated by the same letter are not significantly different at 5 % level according to Duncan' s Multiple Range Test.

Generally increasing seed rate increased plant height due to increased competition affected plant height at the highest seeding rate (which also shortened tillers length). The results are in agreement with those of Stapper and Fischer (1990), Geleta *et al.* (2002), El Hag (2006), Soomro *et al.* (2009), Kiliç and Gürsoy (2010) and Saad (2010). The interaction effect between cultivars and seed rates was highly significant on plant height in the second season only (Table 4). Misr 1 recorded the tallest plant under 300 and 350 seed/m² while Sids 12 recorded the shortest one under 200 seed/m² Table 5. Generally increasing seed rate increased plant height due to increased competition affected plant height at the highest seeding rate (which also shortened tillers length). The results are in agreement with those of Stapper and Fischer (1990), Geleta *et al.* (2002), El Hag (2006), Soomro *et al.* (2009), Kiliç and Gürsoy (2010) and Saad (2010).

Yield components:

In both seasons, data presented in Table 7 indicated that the differences among the two cultivars were significant for number of spikes /m², as well as, Significant differences for 1000 kernels-weight in the 2nd season, and insignificant for number of kernels/spike in both seasons. Misr 1 produced the highest number of spikes /m² (407 and 463), as compared with Sids 12 (390 and 427) in the first and second seasons respectively. Sids 12 recorded the highest values of 1000 - kernel weight (40.8 g) in the second season. Our results are in contrast with Geleta *et al.* (2002), Patrick *et al.* (2003) Abu-Grab *et al.* (2006), Baloch *et al.* (2010) Hussain *et al.* (2010) and Kiliç and Gürsoy (2010).

Regarding seeding rate, the results Table 7 showed highly significant effect on number of spikes /m², in the first season only, and highly significant effect on 1000-kernel weight and number of kernels/spike in both seasons. Increase of seeding rate from 200 to 350 seeds/m² increased gradually number of spikes from 368 to 426 spikes/m² and decreases 1000-kernel weight from 44.9 and 41 to 40.3 and 38 g, and decreased number of kernels /spike from 67 and 64.2 to 62.5 and 59.2 in both seasons, respectively. Obtained results are in good accordance with those previously reported by Ali *et al.* (2004), Soomro *et al.* (2009), Baloch *et al.* (2010) and Kiliç and Gürsoy (2010). The increases in number of fertile tillers were due to increase in numbers of seeds per unit area. On the same time the decreases in 1000-kernel weight and number of kernels/spike were due to the competition on nutrient in soil, moisture, air and light.

Table 7: Mean of number of fertile tillers, 1000-kernel weight (g) and number of kernels /spike as affect by cultivars, seeding rate and their interaction on in 2012/13 and 2013/14 growing seasons

Treatment	Number of spikes/m ²		1000- kernels weight (g)		Number of kernels/spike	
	2012/13	2013/14	2012/13	2013/14	2012/13	2013/14
Cultivars (C):-						
Sids12	390b	427b	43.1	40.8a	65.4	61.2
Misr1	407a	463a	41.9	38.8b	64.2	62.3
F test	*	*	NS	*	NS	NS
Seed rate (Seed/m ²) S:-						
200	368d	433	44.9a	41.0a	67.0a	64.2a
250	390c	437	42.8b	40.7a	65.3ab	62.5b
300	409b	453	42.0bc	39.7b	64.3b	61.0c
350	426a	456	40.3c	38.0c	62.5c	59.2d
F test	**	NS	**	**	**	**
Interaction: -						
C x S	**	NS	NS	NS	NS	NS

Means designated by the same letter are not significantly different at 5 % level according to Duncan' s Multiple Range Test.

The interaction effect among cultivars and seed rates were highly significant effect on number of spikes/m² in the second season only. Sids 12 produced the highest number of spikes (427) with sowing with 350 seeds/m². On the other hand Misr 1 produced 417 and 425 spikes with sowing of 300 and 350 seeds/m² without significant with Sids 12 (Table 5).

Yield:-

Data in Table 8 indicated that insignificant difference's existed between the two cultivars for grain yield, but significant differences on straw yield in both growing seasons and harvest index in the first season. Where Misr 1 recorded the highest values of straw yield (5.829 and 5.266 t/fed.) in the first and second seasons, respectively. Sids 12 recorded the highest harvest index (42.5%) in the first season. Obtained results are in good accordance with those previously reported by Saleh (2000), Geleta *et al.* (2002) El Hag (2006) and Kiliç and Gürsoy (2010).

Table 8: Grain yield (t/fed), straw yield (t/fed), and harvest index% as affected by wheat cultivars, seeding rate and their interaction in 2012/13 and 2013/14 growing seasons

Treatment	Grain yield (t/fed.)		Straw yield (t/fed.)		Harvest index %	
	2012/13	2013/14	2012/13	2013/14	2012/13	2013/14
Cultivar (C)						
Sids12	3.843	3.654	5.195b	4.305b	42.5a	45.9
Misr1	3.946	3.957	5.829a	5.268a	40.4b	42.9
F test	NS	NS	*	*	*	NS
Seed rate (Seed/m ²) S:-						
200	3.673c	3.550b	4.843b	4.383b	43.1	44.7
250	3.834bc	3.680ab	5.576a	4.353b	40.7	45.8
300	3.963ab	3.959a	5.778a	5.091ab	40.7	43.7
350	4.107a	4.033a	5.852a	5.318a	41.2	43.1
F test	**	*	**	*	*	NS
Interaction						
C x S	*	NS	*	NS	*	NS

Means designated by the same letter are not significantly different at 5 % level according to Duncan's Multiple Range Test.

Regarding seeding rates (Table 8), the results showed highly significant and significant effect, on grain and straw yield in both seasons, respectively and on harvest index in the first season only. The highest grain yield was obtained by increasing seeding rate from 200 to 350 seed/m² which increased grain yield from 3.963 and 3.55 to 4.107 and 4.033 t/fed) and straw yield from 4.843 and 4.383 to 5.852,

and 5.318 t/fed. In the first and second season, respectively. Meanwhile, harvest index was decreased by increasing seeding rate. These results are in agreement with those of Allam (2005), El Hag (2006), El Hag-Dalia (2008), Ramadan and Awaad (2008), Baloch *et al.* (2010) and Kiliç and Gürsoy (2010).

The interaction effect between cultivars and seeding rates on grain yield, straw yield and harvest index were significant in the first season (Table 9). Sids 12 and Misr 1 produced 4.13 and 4.09 t/fed) grain. Meanwhile, Misr 1 produced the highest straw yield with sowing of 350 seeds/m² and recorded the highest harvest index with sowing of 200 seeds/m².

Table 9: The interaction effect of seeding rate and cultivars on grain yield, straw yield and harvest index in 2012/13 season

	Grain yield (t/fed)		Straw yield (t/fed)		Harvest index %	
	Sids 12	Misr 1	Sids 12	Misr 1	Sids 12	Misr 1
Seed rate (Seed/m ²) S:-						
200	3.45c	3.89ab	4.81d	4.87cd	41.77ab	44.46a
250	3.83b	3.84b	5.26cd	5.89ab	42.15ab	39.51b
300	3.97ab	3.96ab	5.38bc	6.17a	42.42ab	39.12b
350	4.13a	4.09ab	5.32cd	6.38a	43.67a	39.07b
F test	*		*		*	

Means designated by the same letter are not significantly different at 5 % level according to Duncan's Multiple Range Test.

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تأثير معدلات التقاوى على المحصول ومكوناته لصنفين من قمح الخبز

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اجريت تجربتان حقليتان في المزرعة البحثية بكلية الزراعة - جامعة كفر الشيخ في موسمي 13/2012 و 14/2013 لدراسة تأثير اربع معدلات من التقاوى (200، 250، 300 و 350 حبة/متر²) على المحصول ومكوناته لصنفين من القمح هما سدس 12 ومصر 1. وكان تصميم التجربة في قطع منشقة مرة واحدة في ثلاث مكررات. وضعت الاصناف في القطع الرئيسية ومعدلات التقاوى في القطع الشقية. وتم دراسة الصفات الاتية:- عدد الأيام من الزراعة حتى طرد السنابل والنضج فترة ومعدل إمتلاء الحبوب، ارتفاع النبات، مساحة ورقة العلم، عدد السنابل في المتر المربع ووزن الالف حبة وعدد حبوب السنبل، ومحصولي الحبوب والقش ودليل الحصاد.

تشير النتائج الى تفوق الصنف مصر 1 في عدد الأيام حتى التزهير والنضج ومعدل الامتلاء، ارتفاع النبات، عدد السنابل/متر مربع، ومحصولي الحبوب والقش. أما الصنف سدس 12 تفوق في وزن 1000 حبة ودليل الحصاد. بانخفاض معدل التقاوى زاد كل من عدد الايام حتى طرد السنابل والنضج الفسيولوجي، مساحة ورقة العلم، وزن 1000 حبة، عدد حبوب السنبل و دليل الحصاد. بينما ادت زيادة معدل التقاوى الى زيادة معدل الامتلاء، ارتفاع النبات، عدد السنابل/متر مربع، ومحصولي الحبوب والقش.

بينت نتائج التفاعل بين الاصناف ومعدل التقاوى ان التفاعل كان عالي المعنوية لكل من صفة ارتفاع النبات، عدد السنابل في المتر المربع في الموسم الاول ومعنوى لكل من عدد الايام حتى طرد السنابل في الموسم الثاني ومحصول الحبوب والقش ودليل الحصاد في الموسم الاول. سجل الصنف مصر 1 أعلى عدد من الايام حتى طرد السنابل عند معدل 200 حبة/م² واعلى ارتفاع للنبات عند 350 حبة/متر² وكل من الصنفين سجلا اعلى عدد من السنابل /م² عند معدل تقاوى 350 حبة/ متر². مصر 1 سجل اعلى معدل حصاد عند معدل 200 حبة/ متر² وبدون فرق معنوى مع سدس 12 عند معدل 350 حبة/ متر².