Zagazig J. Agric. Res., Vol. 48 No. (3) 2021 659-669

Plant Production Science

Available online at http://zjar.journals.ekb.eg
http:/www.journals.zu.edu.eg/journalDisplay.aspx?Journalld=1&queryType=Master

# RESPONSE OF SOME WHEAT CULTIVARS TO SOWING METHODS AND SEEDING RATES UNDER SIWA OASIS CONDITIONS

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**Received: 11/02/2021 ; Accepted: 20/06/2021**

**ABSTRACT:** Egypt produces about half of the 20 million tons of consumed wheat and imports the other half. So that Egypt became the world's largest importer of wheat. Therefore, intensive efforts are being for enhancing wheat production to meet any local consumption particularly out of the Nile Valley, *i.e.* Siwa Oasis, Egypt, where salinity is considered of the major problem. However, Siwan farmers are not acquainted with wheat crop from the beginning sustain policy of wheat flour as well as with agricultural practices. Therefore, two on farm trials were carried out in Agricultural Experimental Station of Desert Research Center at Khemisa, Siwa Oasis during 2016/2017 and 2017/2018 growing seasons, to study the effect of sowing methods (broadcast and row) and seeding rates (30, 45, 60 and 75 kg/fed.) on two wheat cultivars, *Triticum aesivum* L., (Misr 2 and Sakha 94). Results indicated that row sowing method produced 37.2% and 12.5% more grain yield over traditional broadcast method in the 1st and 2nd seasons, respectively. These increments may be due to a significant increase in number of spikes/$m^2$, number of grains/spike and to some extent 1000-grain weight. Misr 2 wheat cultivar produced the highest biological, grain yields, harvest index and number of spikes/$m^2$. On the other hand, Sakha 94 cultivar gave the highest value of number of grains/spike and 1000-grain weight in both seasons. The highest values of grain yield and harvest index were noticed with 45 and/or 60 kg/fed seeding rates in two seasons. Whereas, a gradual significant increase in number of spikes/$m^2$ and biological yield was noticed with increasing seeding rates from 30 up to 75 kg/fed. However, 1000-grain weight tended to reduce with increasing seeding rates. So, it could be concluded that sowing Misr 2 wheat cultivar at 60 kg/fed., with row sowing method is suitable for wheat production under saline conditions at Siwa Oasis.

**Key words:** Wheat cultivar, sowing methods, seeding rate, salinity, grain yield.

## INTRODUCTION

Wheat (*Triticum aestivum* L.) is the most important cereal crop as a food grain in Egypt and the world. However, depending on Nile valley and Delta governorates under irrigation system, Egypt produces about half of the 20 million tons of wheat consumed annually with imports the other half **(MALR, 2014; Asseng *et al.*, 2018).** According to **FAO (2018**), the total planted area of wheat in Egypt 1.37 million hectares with a total production of 9 million tons. The total consumption in Egypt is around 19 million tons, this wide gap between consumption and actual production forces the country to import 10 million tons to close this gape **(FAO STAT, 2020)**. Moreover, Egypt population is currently growing at 2.2% annually, and projections indicate that the demand for wheat will triple by the end of the century **(Roser and Ortiz-Ospina 2017).** Therefore, intensive our efforts are being for wheat production to meet any local consumption particularly out of the Nile Valley. Siwian farmers at Siwa Oasis, depending upon underground saline water, are not acquainted with agricultural practices of such crop. Whereas, wheat cultivars differed significantly in their relative yield reduction by salinity. So identifying wheat cultivars that able to tolerate salt stress conditions is one of the

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cheap method for transferable technology to spread wheat cvs on Siwan farmers **(Munns *et al*., 2006; Hassan *et al*., 2014; Gadallah *et al*., 2017).**

Seeding rate of any crop is one of the important production factors. Although, wheat varieties were released with recommended seed rates, however, the optimum seeding rate alters according to many factors, i.e. variety, location, soil type and conditions, sowing date and method etc. Wheat is sowing by broadcasting on a large scale in Egypt which do not only requires higher seed rate but also results in untidy plant population. On the other hand, drill sowing method is recommended because of its uniform seed distribution and planting at desired depth, which usually results in higher germination and uniform stand. In this regard, **Rafique *et al.* (2010)** reported that increasing seeding rate above the optimum level may only enhance wheat production cost without any increase in grain yield. **El-Hawary *et al.* (2019**) the effect of seeding rates was significant on number of spikes-$m^2$,spike length, number of grain per spike, grain yield ,straw yield kg-fed , in both seasons, while harvest index was significantly in the second season ,On the other hand ,1000 grain weight was insignificant affected in both seasons . Sowing wheat plants at seeding rate of 600 seeds –$m^2$ gave the highest number of spikes –$m^2$,672and 717.06 and number of grain per spike 32.42 and 42.64 , grain yield , and straw yield in both seasons (10.95 and 12.45 & 2.12 and 2.77), as compared with other seeding rates in both seasons. **Iqtidar *et al.* (2010)** studied the effect of different seed rates (50, 100, 150 and 200 kg seed $ha^{-1}$) on grain yield of six wheat varieties. Maximum grain yield were produced from Daman-98, Raj, Dera-98 and Punjab-96 wheat varieties at seeding rates of 200, 50, 100 and 150 kg $ha^{-1}$, respectively. Daman-98, Inqilab-91 and Bakhtawar-92 produced maximum grain yield at higher seed rate. Whereas, Raj produced maximum grain yield at 50 kg seed $ha^{-1}$. Moreover, **Shalaldeh and Thalji (2007)** investigated the effects of plant population (300, 350 and 400 plants/$m^2$) on the performance of five wheat genotypes (Jumaizeh, Bin-bashair, Cham-3, Cham-6 and Snb1s1) under salinity conditions at Central Jordan Valley. They noticed that wheat genotypes did not differ significantly in grain and straw yields. Plant population of 400 plant $m^{-2}$ gave the highest biological, grain and straw yields. For the interaction effects, Jumaizeh at 400 plants/$m^2$ gave a significant increase in biological, grain and straw yields. A plant population at 400 plant $m^2$ is recommended for the highest yield of wheat when planted under saline conditions. **Tadesse *et al.* (2017)** studied the effect of two sowing methods namely row planting and broadcasting with six seed rate, 125, 150, 175, 200, 225 and 250 kg/ha. on yield of bread wheat at south arid district, south Omo zone, Snnpr, Ethiopia. They found that maximum and minimum grain yields were obtained from 125 and 200 kg $ha^{-1}$ seed rates, respectively. Also, maximum and least grain yield were obtained from row and broadcast methods, respectively. **Chauhdary *et al.* (2016)** studied the effect of sowing methods (broadcasting, drill sowing, bed planting) and seed rates (100, 130, and 160 kg/ha) on wheat yield and water productivity. They recommended that wheat should be sown with seed rate of 160 kg/ha under bed planting for economically better yield and water productivity in the semi-arid area of Faisalabad, Pakistan

The planting modes plays crucial role in productivity and the farmer select the mode depending on soil type and the preceding crops as follow: the affir method (sowing dry seed in dry land) is divided into broadcasting and drilling methods (planter). Most farmers prefer the broadcasting method because it saves time and a drill is not required. The method is suitable for saline, alkaline and light soil but this method is not suitable for lands with allergy number of weeds. Experts recommended the drill method, which convenient for mechanization and coast saving, improves wheat population structure and yield, and increase he utilization efficiency of light, water, fertilizer and other resources **(Tao *et al.*, 2018)**.

**Javed *et al.* (2020)** reported that wheat productivity could be improved by ridge sown with optimized seed rate for different varieties. Wheat varieties (Faisalabad -8, Punjab-11 and Galaxy -13) were sown in ridges using two different seed rates (125 and 150 kg $ha^{-1}$). Increase in seed rate improve the emergence plant per $m^2$, number of productive tillers and grain yield (3-7%) of all wheat varieties,

although productive tillers per plant, number of grains per spike and 100 grain weight was decrease. Increase in seed rate improved the grin yield of ridge sown wheat by enhancing the number of productive tillers per unit area and could be exploited to improve the wheat productivity

Therefore, this study was conducted to determine the optimum seeding rate of any wheat cvs with the available sowing method for wheat Siwan farmers.

## MATERIALS AND METHODS

Two on farm trials were carried out in the Agricultural Experimental Station of Desert Research Center at Khemisa farm, Siwa Oasis, during 2016/2017 and 2017/2018 growing seasons. These trials were performed to study the effect of seeding rates (30, 45, 60 and 75 kg/ fed.) of two wheat (*Triticum aestivum* L.) cultivars, *i.e.* Sakha 94 and Miser 2 under two sowing methods of drill in rows and broadcasting. The experimental design was split-split plot design with 3 replicates in both growing seasons. Sowing methods were randomly arranged in the main plots, while, wheat cultivars were randomly arranged in the sub-plots, and seeding rates were allocated at random in the sub-sub-plots. Each sub-sub plot area was 20 $m^2$ (4 x 5 m) containing 20 rows in drill sowing method. The soil type of the experimental site was sandy in texture with pH 7.5, CaCO3 3.6%, organic matter 0.5% and EC 4.1 $dSm^{-1}$. Plants were irrigated with brackish water which contained 2709 ppm as total dissolved salts.

Grains of two wheat cultivars were sown on November, 4$^{th}$ week in both growing seasons. Prior to sowing, 20 $m^3$ organic manure and 30 kg $P_2O_5$ per feddan,as calcium superphosphate (15.5% $P_2O_5$) were added during the soil preparation as well as 15 kg N/fed., was added at sowing time. Moreover, 30.0 kg N/fed. as ammonium nitrate (33.5% N) were added twice after 45 and 60 days from sowing date. At harvest date, at 4$^{th}$ week of April, no. of spikes/$m^2$, no. of grains/spike, 1000-grain wt. (g), grain, straw and biological yields per fed., as well as harvest index were recorded. Analysis of variance and mean values were compared by using least significant difference test (LSD) at 5% level **(Steel *et al.*, 1997)**.

## RESULTS AND DISCUSSION

### Effect of Sowing Methods

Results in Table 1 show that effect of sowing methods on grain yield and yield attributes, *i.e.* No. of spikes/$m^2$, No. of grains/spike, 1000-grain weight, grain and biological yields as well as harvest index. Sowing methods had a significant effect on yield and all yield attributes except biological yield in the 2$^{nd}$ season. Biological, in the 1$^{st}$ season, grain yield and harvest index, in both seasons were significantly increased with row sowing method. It is obvious that row sowing method produced 37.2% and 12.5% more grain yield over traditional broadcast method in the 1$^{st}$ and 2$^{nd}$ seasons, respectively. These results may be due to one or more reasons, 1) A significant increase in the two triangle yield components of number of spikes/$m^2$ and number of grains/spike in both seasons and/or 2) most spikes in case of row method were produced from main stems, whereas, in case broadcasting, they were produced from tillers **(Hassan and Hassan, 1994).** Moreover, This result may be due to uniform germination and regular well stand in row method whereas, in broadcast method, germination is relatively poor and irregular stand as shown from number of seedlings/$m^2$, In this respect, many authors noticed the same findings, *i.e.* **Soomro *et al*. (2009), Dagash *et al*. (2014), Tesfaye (2015), Tadesse *et al*. (2017 and Tao *et al.* (2018)** who reported that the maximum and least grain yield were obtained from row and broadcast methods, respectively. **Chauhdary *et al.* (2016)** reported that wheat sowing on raised-beds showed highest plant height, numbers of tillers, numbers of grains per spike, 1000 grain weight, grain yield and water productivity, while these parameters were observed as the lowest under broadcasting. Moreover, wheat on beds produced 13% more yield and saved 35% water in comparison to that under broadcasting.

### Effect of Wheat Cultivars

Wheat cultivars had a significant effect on biological yield, grain yield, harvest index and yield attributes of number of spikes/$m^2$, number of grains/spike and 1000-grain weight in both seasons except grain yield and harvest index in

**Table 1. Effect of sowing methods on wheat productivity in two growing seasons (2016/2017 and 2017/2018)**

| Sowing methods | Wheat yield and yield attributes | | | | | |
|---|---|---|---|---|---|---|
| | Number of spikes/$m^2$ | Number of grains/spike | 1000-grain wt. (g) | Grain yield (ton/fed.) | Biological yield (ton/fed.) | Harvest index (%) |
| | | | 1st growing season (2016/2017) | | | |
| **Broadcasting method** | 527.0 b | 49.8 b | 41.1 a | 1.620b | 4.819b | 32.8 b |
| **Row method** | 614.4 a | 52.8 a | 38.4 b | 2.700a | 7.436a | 36.8 a |
| | | | 2nd growing season (2017/2018) | | | |
| **Broadcasting method** | 579.2 b | 53.9 b | 43.14a | 2.162b | 6.754a | 32.1 b |
| **Row method** | 682.8 a | 56.8 a | 40.31b | 2.471a | 6.661a | 37.0 a |

the 2nd season (Table 2). The highest biological, grain yields, harvest index and number of spikes/$m^2$ were recorded by Misr 2 wheat cultivar. On the other hand, Sakha 94 cultivar gave the highest value of number of grains/spike and 1000-grain weight in both seasons. This could be due to genotypic differences between the two wheat cultivars **(Iqtidar *et al*., 2010; Tesfaye, 2015)**. In addition, **Hassan and Hassan (1994), Munns *et al*. (2006), Hassan *et al.* (2014) and Gadallah *et al*. (2017)** noticed that the varietal differences of wheat crop to salt tolerance.

## Effect of Seeding Rates

In the 1st season, a gradual significant increase in biological yield was noticed by increasing seeding rates from 30 up to 75 kg/fed., with no significant differences between 45 and 60 kg/fed., seeding rates (Table 3). Whereas, in the 2nd one, a gradual decrease in biological and grain yields were recorded by increasing seeding rates from 45 up to 75 kg/fed. Therefore, the lowest values of biological and grain yields as well as harvest index were obtained from the lowest seeding rate of 30 kg/fed in both seasons. The highest values of grain yield and harvest index were noticed with 45 and/or 60 kg/fed., seeding rates in two seasons. **Tadesse *et al.* (2017)** reported that the maximum and minimum grain yield was obtained from seed rates of 125 and 200 kg $ha^{-1}$, respectively.

Number of spikes/$m^2$ was increased significantly with increasing seeding rates from 30 to 75 kg/$m^2$ in both seasons. While, seeding rate of 60 kg/fed. gave the highest value of number of grains/spike in two seasons as shown in Table 3. The reverse was true with the lowest seeding rate (30 kg/fed.) in both seasons. In this regard, **Ozturk *et al.* (2006)** using seven seeding rates (325, 375, 425, 475, 525, 575 and 625 seeds $m^{-2}$), found that increasing seeding rate up to 525 seeds $m^{-2}$ increased the spikes per square meter, resulting in increased grain yield.

As seeding rates increased from 30 to 75 kg/fed., 1000-grain weight tended to reduce with no significant differences between 30 and 60 seeding rates in the 1st season. Moreover, the highest and lowest values of thousand seed weight were observed at 30 and 75 kg/fed. seeding rates, respectively (Table 3). This result may be due to the reverse relationship between this yield attribute and number of spikes/$m^2$ as noticed from our and other results of **Tesfaye (2015)**. Moreover, **Chauhdary *et al.* (2016)** tried 100, 130, and 160 kg/ha, noticed that the highest grain yield, water productivity and numbers of tillers, but lowest numbers of grains per spike and 1000 grain weight were obtained from seed rate of 160 kg/ha. Seed rate of 100 kg/ha produced the highest numbers of grains per spike and 1000 grain weight but lowest numbers of tillers, grain yield and water productivity.

**Table 2. Effect of wheat cultivars on wheat productivity in two growing seasons (2016/2017 and 2017/2018)**

| Wheat cultivars | Wheat yield and yield attributes | | | | | |
|---|---|---|---|---|---|---|
| | Number of spikes/$m^2$ | Number of grains/spike | 1000-grain wt. (g) | Grain yield (ton/fed.) | Biological yield (ton/fed.) | Harvest index (%) |
| | | | 1st growing season (2016/2017) | | | |
| **Misr 2** | 593.8 a | 49.5 b | 37.2 b | 2.621 a | 6.405 a | 40.2 a |
| **Sakha 94** | 547.5 b | 53.1 a | 42.3 a | 1.579 b | 5.850 b | 29.4 b |
| | | | 2nd growing season (2017/2018) | | | |
| **Misr 2** | 653.5 a | 53.5b | 39.11b | 2.340 a | 7.002 a | 33.5 a |
| **Sakha 94** | 608.5 b | 57.2a | 44.42a | 2.280 a | 6.409 b | 35.6 a |

**Table 3. Effect of seeding rates on wheat productivity in two growing seasons (2016/2017 and 2017/2018)**

| Sowing rates (kg/fed.) | Wheat yield and yield attributes | | | | | |
|---|---|---|---|---|---|---|
| | Number of spikes/$m^2$ | Number of grains/spike | 1000-grain wt. (g) | Grain yield (ton/fed.) | Biological yield (ton/fed.) | Harvest index (%) |
| | | | 1st growing season (2016/2017) | | | |
| **30** | 542.9 d | 48.5 c | 40.4 a | 1.448 c | 5.100 c | 27.3 c |
| **45** | 561.7 c | 50.9 b | 39.1 c | 2.528 a | 6.075 b | 39.8 a |
| **60** | 575.9 b | 53.3 a | 40.0 ab | 2.275 b | 6.158 b | 36.2 b |
| **75** | 602.3 a | 52.5 a | 39.5 bc | 2.401 ab | 7.178 a | 35.8 b |
| | | | 2nd growing season (2017/2018) | | | |
| **30** | 597.2d | 52.3 d | 42.42a | 2.014 d | 6.120 d | 33.2 c |
| **45** | 622.2 c | 54.2 c | 41.05c | 2.596 a | 7.560 a | 34.4 b |
| **60** | 642.4 b | 58.0 a | 42.06ab | 2.509 b | 6.773 b | 37.0 a |
| **75** | 662.2 a | 56.8 b | 41.53bc | 2.122 c | 6.372 c | 33.6 bc |

## Effect of the Interaction between Sowing Methods and Wheat Cultivars

The maximum value of biological yield was obtained from Sakha 94, in the 1st season, and Misr 2 in the 2nd one with row sowing method (Table 4). Whereas, broadcasting method produced lower values of the two evaluated wheat cultivars in both seasons. On the other hand, row sowing method gave a significant increase in grain yield of Misr 2 wheat cv. in both seasons. While, using broadcasting sowing method with Sakha 94 produced the lower values of grain yield in both seasons. In addition, broadcast method gave lower values of harvest index of the both wheat cvs in both seasons. However, the highest value of harvest index was obtained from Misr2 in the 1st season and Sakha 94 in the 2nd one with row sowing method.

**Table 4. Effect of the interaction between sowing methods and wheat cultivars on wheat productivity in two growing seasons (2016/2017 and 2017/2018)**

| Sowing methods | Wheat cvs. | Wheat yield and yield attributes | | | | | |
|---|---|---|---|---|---|---|---|
| | | Number of spikes/$m^2$ | Number of grains/ spike | 1000-grain wt. (g) | Grain yield (ton/fed.) | Biological yield (ton/fed.) | Harvest index (%) |
| | | **1st growing season (2016/2017)** | | | | | |
| **Broad-casting** | **Misr 2** | 549.0 c | 48.2 c | 39.3 c | 1.939 b | 5.437 c | 35.5 b |
| | **Sakha 94** | 505.0 d | 51.5 b | 42.8 a | 1.302 c | 4.200 d | 30.2 c |
| | **Misr 2** | 638.7 a | 50.8 b | 35.1 d | 3.303 a | 7.373 b | 44.9 a |
| **Row** | **Sakha 94** | 590.1 b | 54.8 a | 41.7 b | 2.111 b | 7.500 a | 28.6 c |
| | | **2nd growing season (2017/2018)** | | | | | |
| **Broad-casting** | **Misr 2** | 604.1 c | 52.0 c | 41.31c | 2.145 c | 6.779 b | 31.7 c |
| | **Sakha 94** | 554.3 d | 55.8 b | 44.96a | 2.187 c | 6.720 b | 32.5 c |
| | **Misr 2** | 702.9 a | 55.0 b | 36.83d | 2.543 a | 7.224 a | 35.4 b |
| **Row** | **Sakha 94** | 662.6 b | 58.5 a | 43.81b | 2.373 b | 6.098 c | 38.6 a |

A pronounced increase in number of spikes/$m^2$ of Misr 2, and to some extent, Sakha 94 wheat cv was noticed with row sowing method in both seasons. Whereas, the reverse was true with broadcasting sowing method. Moreover, the highest value of 1000-grain weight was obtained from plants sown in row than that of broadcasted in both wheat cultivars. In this regard, **Tesfaye (2015)** found that Molgo variety produced grain yield and grain weight more than Digelu variety in broadcast and row sowing methods.

## Effect of the Interaction between Sowing Methods and Seeding Rates

Results presented in Table 5 show the effect of sowing methods and seeding rates on biological, grain yield and its attributes as well as harvest index in both seasons. In the 1st season, a significant increase in biological yield was recorded with row sowing method at different seeding rates as compared with the other method. Moreover, there are a gradual increase in biological yield was noticed with increasing seeding rates from 30 to 75 kg/fed., at both sowing methods. On the other hand, in the 2nd one, seeding rate of 45 and to some extent, 60 kg/fed., with row followed by broadcast method produced higher values of biological yield. While, the lowest value of biological yield was obtained from the lowest seeding rate at any sowing methods in both seasons.

Row method at 45 and 60 kg/fed., seeding rate in both seasons gave the highest values of grain yield and harvest index. Whereas, broadcasting method at 30 up to 60 kg/fed., in the 1st season, 30 and 75 kg/fed., in the 2nd one produced the lowest values of grain yield. Moreover, seeding rate at 30 kg/fed., with broadcasting method gave the lowest values of harvest index in both seasons. In this respect, **Soomro *et al.* (2009)** used three sowing methods (drilling, broadcasting and broadcasting in standing water) and seed rates (125, 150 and 175 kg/ha), found that wheat sown by drilling method at the seed rate of 150 kg/ha significantly increased yield. Whereas **Tadesse *et al.* (2017)** reported that the maximum grain yield was obtained from row planting at seed rate of 125 kg $ha^{-1}$. Whereas, the reverse was true for broadcast method at rate of 200 kg $ha^{-1}$

A gradual significant increase in number of spikes/$m^2$ was noticed with increasing seeding

**Table 5. Effect of the interaction between sowing methods and seeding rates on wheat productivity in two growing seasons (2016/2017 and 2017/2018)**

| Sowing methods | Sowing rates (kg/fed.) | Wheat yield and yield attributes | | | | | |
|---|---|---|---|---|---|---|---|
| | | Number of spikes/$m^2$ | Number of grains/ spike | 1000-grain wt. (g) | Grain yield (ton/fed.) | Biological yield (ton/fed.) | Harvest index (%) |
| | | **1st growing season (2016/2017)** | | | | | |
| **Broad-casting** | **30** | 510.2 h | 47.5 e | 40.9 ab | 1.134 f | 4.036 g | 27. 5 e |
| | **45** | 521.7 g | 49.7 d | 41.7 a | 1.614 e | 4.696 f | 33.1 c |
| | **60** | 531.0 f | 51.4 cd | 40.7 ab | 1.588 e | 5.280 e | 30.0 de |
| | **75** | 545.2 e | 50.7 cd | 41.0 ab | 2.149 d | 5.266 e | 40.7 b |
| **Row** | **30** | 575.7 d | 49.6 de | 39.8 bc | 1.762 e | 6.166 d | 27.1 e |
| | **45** | 601.7 c | 52.2 bc | 36.5 e | 3.442 a | 7.456 b | 46.6 a |
| | **60** | 620.8 b | 55.2 a | 39.3 c | 2.962 b | 7.036 c | 42.4 b |
| | **75** | 659.3 a | 54.2 ab | 38.0 d | 2.651 c | 9.090 a | 30.9 cd |
| | | **2nd growing season (2017/2018)** | | | | | |
| **Broad-casting** | **30** | 561.2 g | 51.0 e | 43ab | 1.943 e | 6.275 e | 31.0 d |
| | **45** | 573.7 f | 53.3 d | 43.74a | 2.325 c | 7.148 b | 32.5 c |
| | **60** | 582.3 f | 56.3 b | 42.78ab | 2.287 c | 6.930 c | 33.0 c |
| | **75** | 599.7 e | 54.9 bcd | 43.05ab | 2.093 d | 6.653 d | 31.9 cd |
| **Row** | **30** | 633.2 d | 53.6 cd | 41.84bc | 2.136 d | 5.972 f | 35.4 b |
| | **45** | 670.7 c | 55.2 bc | 38.28e | 2.867 a | 7.972 a | 36.3 b |
| | **60** | 702.5 b | 59.7 a | 41.21c | 2.730 b | 6.552 d | 41.0 a |
| | **75** | 724.7 a | 58.6 a | 39.9d | 2.151 d | 6.098 ef | 35.2 b |

rates from 30 to 75 kg/fed., either with row or broadcasting methods in both seasons. However, number of spikes/$m^2$ at any seeding rates of row method surpassed significantly the same seeding rate of broadcasting method.

Seeding rate of 60 kg-fed., applied by row method produce the highest value of number of grains-spike. Whereas, the lowest one was recorded with broadcast method at 30 kg-fed .seeding rate in both seasons. Number of grains-spike tented to increase with row method at any seeding rate compared with the same rate of the other sowing method. **Chauhdary *et al.* (2016)** investigated three seed rates (100, 130, and 160 kg/ha) and three sowing methods (broadcasting, drill sowing, bed planting) on wheat yield and water productivity. They recommended that wheat should be sown with seed rate of 160 kg/ha under bed planting for economically better yield and water productivity in the semi-arid area of Faisalabad, Pakistan.

## Effect of the Interaction between Wheat Cultivars and Seeding Rates

Sakha 94 wheat cv. at 75 and Misr 2 cv. at 45 kg/fed., gave the highest values of biological yield in the 1st season. The same findings were true for the two cultivars at 45 kg/fed., in the 2nd one (Table 6). Although, biological yield of Sakha 94 tended to increase significantly with increasing seeding rates from 30 up to75 kg/fed., in the 1st season. Whereas, biological yield of Misr 2 cv. was increased significantly with increasing seeding rates from 30 up to 45 kg/fed., in the two seasons. These results may be attributed to the differences between 1000-grain weight, where Sakha 94 cv. have higher value of 1000-grain weight than Misr2 cv. as shown in Table 6.

**Table 6. Effect of the interaction between wheat cultivars and seeding rates on wheat productivity in two growing seasons (2016/2017 and 2017/2018)**

| Wheat cvs. | Sowing rates (kg/fed.) | Wheat yield and yield attributes | | | | | |
|---|---|---|---|---|---|---|---|
| | | Number of spikes/$m^2$ | Number of grains/ spike | 1000-grain wt. (g) | Grain yield (ton/fed.) | Biological yield (ton/fed.) | Harvest index (%) |
| | | **1st growing season (2016/2017)** | | | | | |
| | **30** | 565.3 d | 46.8 e | 39.0 b | 2.247 c | 5.940 e | 36.9 c |
| | **45** | 583.2 c | 49.0 d | 35.7 c | 2.871 a | 7.005 b | 40.6 ab |
| **Misr 2** | **60** | 599.8 b | 51.8 bc | 38.3 b | 2.458 b | 5.940 e | 40.3 ab |
| | **75** | 627.0 a | 50.6 cd | 36.0 c | 2.910 a | 6.735 c | 43.0 a |
| | **30** | 520.5 g | 50.3 cd | 41.8 a | 0.648 e | 4.260 g | 17.6 f |
| | **45** | 540.2 f | 52.9 ab | 42.5 a | 2.185 c | 5.145 f | 39.0 bc |
| **Sakha 94** | **60** | 552.0 e | 54.9 a | 41.8 a | 2.091 c | 6.375 d | 32.1 d |
| | **75** | 577.5 c | 54.4 a | 43.1 a | 1.891 d | 7.620 a | 28.6 e |
| | | **2nd growing season (2017/2018)** | | | | | |
| | **30** | 621.7 e | 50.2 d | 40.95b | 2.047 e | 6.598 d | 31.0 e |
| | **45** | 642.7 c | 53.0 c | 37.48c | 2.524bc | 7.749 a | 32.5 d |
| **Misr 2** | **60** | 660.0 b | 56.0 b | 40.22b | 2.543 b | 6.993 c | 36.3 b |
| | **75** | 689.7 a | 54.7 bc | 37.80c | 2.247 d | 6.661 d | 34.3 c |
| | **30** | 572.7 g | 54.4 bc | 43.89a | 1.981 e | 5.641 f | 35.4 bc |
| | **45** | 601.7 f | 55.4 b | 44.63a | 2.668 a | 7.371 b | 36.3 b |
| **Sakha 94** | **60** | 624.8 de | 60.0 a | 43.89a | 2.474 c | 6.552 d | 37.7 a |
| | **75** | 634.7 cd | 58.8 a | 45.26a | 1.997 e | 6.082 e | 32.8 d |

Misr 2 cv. at 45 and 75 kg/fed., seeding rates produced higher values of grain yield and harvest index in the 1st season. However, in the 2nd one, this was true for Sakha 94 at 45 kg/fed., and Misr 2 at 60 kg/fed. These results may be due to increasing No. of spikes/$m^2$ of Misr 2 cv. at 75 kg/fed., in both seasons and/or increasing 1000-grain weight of Sakha 94 in the 1st season. In this respect, **Iqtidar *et al.* (2010)** found that maximum grain yield was produced from Daman-98, Raj, Dera-98 and Punjab-96 wheat varieties at seeding rates of 200, 50, 100 and 150 kg ha-1, respectively. Daman-98, Inqilab-91 and Bakhtawar-92 produced maximum grain yield at higher seed rate. Whereas, Raj produced maximum grain yield of 5.0 t $ha^{-1}$ at 50 kg seed $ha^{-1}$.

A gradual increase in No. of spikes/$m^2$ was recorded with increasing seeding rates from 30 up to 75 kg/fed., of the two cultivars. This finding was expected. However, at any sowing rate, Misr 2 wheat cv. surpassed significantly in this trait. This result may be attributed to the lower value of 1000-grain wt. of Misr 2 wheat cv. as compared with the other one. **Shalaldeh and Thalji (2007)** showed that Jumaizeh wheat genotype at 400 plants/$m^2$ gave a significant increase in biological, grain and straw yields as compared with the other four genotypes at the other plant populations of 300 and 350 plants/$m^2$. **Abuzaytonh (2020)** studied effect of seed rates on the yield and yield components of five soft wheat varieties (*Ttiticum aestiv*um L.) under the sandy soil conditions of the Kufra region, Libya, clear that the seed rate and variety used are important in increasing the grain yield of wheat under the conditions of the study area, as the increase in seed rates led to an increase in the grain yield ton-h by a rate of 11.70%, it was also found the seri variety exceeded its grain yield ton-ha over the rest of the studied varieties.

## Effect of the Interaction between Sowing Method, Rates and Wheat Cultivars

Sowing wheat cultivar Sakha 94 cv. at 75 kg/fed., and Misr 2 cv., at 45 kg/fed., by row sowing method produced the highest values of biological yield in 1st and 2nd seasons, respectively. Whereas, the lowest value of biological yield was obtained from Sakha 94, at 30 kg/fed., with broadcasting and row sowing methods, in the 1st and 2nd seasons, respectively (Table 7).

**Table 7. Effect of the interaction between sowing methods and seeding rates on productivity of two wheat cultivars in two growing seasons (2016/2017 and 2017/2018)**

| Sowing Methods | Wheat cvs. | Sowing rates (kg/fed.) | Wheat yield and yield attributes | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Number of spikes/$m^2$ | No. of grains/ spike | 1000-grain wt. (g) | Grain yield (ton/fed.) | Biological yield (ton/fed.) | Harvest index (%) |
| | | | **1st growing season (2016/2017)** | | | | | |
| Broad-casting | Misr2 | 30 | 531.7 h | 45.8 g | 39.8 def | 1.541 g | 5.19 ij | 29.7 e |
| | | 45 | 543.7 g | 47.8 fg | 38.2 fg | 2.241 de | 5.82 f | 38.6 cd |
| | | 60 | 552.7 g | 50.3 def | 39.1 efg | 1.660 g | 5.22 ij | 31.8 e |
| | | 75 | 568.0 f | 48.9 efg | 40.3 cde | 2.315 d | 5.52 gh | 41.8 bc |
| | Sakha 94 | 30 | 488.7 j | 49.1 ef | 42.1 bc | 0.726 hi | 2.88 l | 25.2 f |
| | | 45 | 499.7 i | 51.6 cde | 45.1 a | 0.986 h | 3.57 k | 27.6 ef |
| | | 60 | 509.3 i | 52.6 cd | 42.4 b | 1.514 g | 5.34 hi | 28.3 ef |
| | | 75 | 522.3 h | 52.6 cd | 41.7 bcd | 1.981 ef | 5.01 j | 39.5 cd |
| Row | Misr2 | 30 | 599.0 d | 47.7 fg | 38.2 fg | 2.953 b | 6.69 c | 44.2 b |
| | | 45 | 622.7 c | 50.2 def | 33.1 h | 3.501 a | 8.19 b | 42.7 bc |
| | | 60 | 647.0 b | 53.3 bcd | 37.4 g | 3.256 a | 6.66 c | 48.9 a |
| | | 75 | 686.0 a | 52.2 cde | 31.6 h | 3.504 a | 7.95 c | 44.1 b |
| | Sakha 94 | 30 | 552.3 g | 51.4 cde | 41.5 bcd | 0.570 i | 5.64 fg | 10.1 h |
| | | 45 | 580.7 e | 54.2 abc | 39.9 def | 3.384 a | 6.72 e | 50.5 a |
| | | 60 | 594.7 d | 57.2 a | 41.1 bcd | 2.668 c | 7.41 d | 36.0 d |
| | | 75 | 632.7 c | 56.2 ab | 44.4 a | 1.800 fg | 10.23 a | 17.7 g |
| | | | **2nd growing season (2017/2018)** | | | | | |
| Broad-casting | Misr2 | 30 | 548.7 gh | 48.9 g | 41.79def | 1.936 g | 6.451 ij | 30.0 e |
| | | 45 | 598.0 fg | 51.7 f | 40.11fg | 2.142 f | 6.695 ef | 32.0 de |
| | | 60 | 608.3 f | 54.4 cde | 41.05efg | 2.287 e | 6.930 cde | 33.0 d |
| | | 75 | 625.3 e | 52.9 ef | 42.32cde | 2.182 ef | 7.039 cde | 31.8 de |
| | Sakha 94 | 30 | 537.7 j | 53.1 def | 44.21bc | 1.949 g | 6.090 hi | 32.0 de |
| | | 45 | 549.3 ij | 54.9 cde | 47.36a | 2.508 d | 7.602 b | 33.1 d |
| | | 60 | 556.3 i | 58.3 b | 44.52b | 2.287 e | 6.930 cde | 33.0 d |
| | | 75 | 574.0 h | 56.8 bc | 43.78bcd | 2.003 g | 6.258 gh | 32.0 de |
| Row | Misr2 | 30 | 658.7 d | 51.6 f | 40.11fg | 2.158 f | 6.745 def | 32.0 de |
| | | 45 | 687.3 c | 54.4 cde | 34.76h | 2.905 a | 8.803 a | 33.0 d |
| | | 60 | 711.7 b | 57.6 b | 39.27g | 2.799 b | 7.056 cd | 39.6 b |
| | | 75 | 754.0 a | 56.5 bc | 33.18h | 2.311 e | 6.283 gh | 36.8 c |
| | Sakha 94 | 30 | 607.7 f | 55.6 bcd | 43.58bcd | 2.013 g | 5.191 j | 38.8 b |
| | | 45 | 654.0 d | 55.9 bc | 41.89def | 2.828 ab | 7.140 c | 39.6 b |
| | | 60 | 693.3 c | 61.8 a | 43.15bcd | 2.661 c | 6.174 gh | 42.4 a |
| | | 75 | 695.3 c | 60.8 a | 46.62a | 1.990 g | 5.905 i | 33.7 d |

Sowing Misr2 followed by Sakha 94 wheat cvs., at 45 kg/fed., by row sowing method gave the higher values of grain yield in both seasons. Also, sowing Misr 2 and Sakha 94 wheat cvs., in row sowing method at seeding rates of 45 and/or 60 kg/fed., gave the higher values of harvest index in both seasons. The reverse was true for Sakha 94 cv., at the lowest seeding rate of 30 kg/fed., with broadcasting method.

**Chuan Li *et al.* (2020)** reported that seed rate influenced the grain yield, yield parameters and grain quality. For grain yield, the optimum seed rate was 225 kg $ha^{-1}$. In conclusion, depending on the end use of wheat, different seed rates should be used in the study, or even because other sowing methods produced desirable results as well. Therefore, further studies are recommended using different varieties with a wide genetic diversity

Number of spikes/$m^2$ of both wheat cultivars was increased significantly with increasing seeding rates from 30 to 75 kg/fed., with the two sowing methods in both seasons. But, row sowing method at any seeding rates of Misr 2 cv. surpassed significantly the other cv. of Sakha 94 in number of spikes/$m^2$.

Sowing Sakha 94 cv. at 60 kg/fed., seeding rate using row method produced the highest value of number of grains/spike in both seasons. The reverse was true for sowing Misr2 cv. at 30 kg/fed., seeding rate using broadcast method. Thus, it could be concluded that row sowing method of Misr 2 wheat cultivar at seeding rate of 60 kg/fed., is a suitable for providing sustainable yield under salinity conditions at Siwa Oasis.

## REFERENCES

Abouzaytonh, A.M. (2020). Effect of seed rates on the yield and yield components of five soft wheat varieties (*Triticum aestivum* L.) under the sandy soil conditions of the Kufra region, Libya. Int. J. Biological, Physical and Chem. Studies, 2 (2):15-22.

Asseng, S., A.M.S. Kheir, B.T. Kassie, G. Hoogenboom, A.I.N. Andelaal, D.Z. Haman and A.C. Ruane (2018). Can Egypt become self-sufficient in wheat? Environ. Res. Lett., 13 (9): 1-11

Chauhdary, J.N., U.D. Khan, S. Shah and M.A. Shahid (2016). Effect of sowing methods and seed rates on wheat yield and water productivity. Crop and Food, 8 (2): 1-6.

Chuan, L., T.Q. Hao, B.J. Shio and J.B. Hai (2020). The combined effect of different sowing methods and seed rates on the quality features and yield of winter wheat. Agric. (MDPI), 10 (5): 1-20

Dagash Y.M.I., I.M.M. Syed Ahmed and N.A. Khalil (2014). Effect of nitrogen fertilization, sowing methods and sowing dates on yield and yield attributes of wheat (*Triticum aestivum* L). Univ. J. Plant Sci., 2 (6): 108-113.

El-Hawary, M.A., G.H. Abd El-Hag, M.A. Attia and M.I. Zaire (2019). Effect of Belcocel and nitrogen fertilizer rates on yield and yield components of wheat under North Sinai conditions Al-Azhar J. Agric. Res., 1 (44): 88-99.

FAO (2018). FAO STAT, Wheat Production Statistics www.fao. Org/faostat/ en/#data/TP.

FAO (2020). FAO STAT, Wheat Production Statistics www.fao. Org/faostat/ en/#data/TP.

Gadallah, M.A., S.I. Milad, Y.M. Mabrook, A.Y. Abo Yossef and M.A. Gouda (2017). Evaluation of some Egyptian Bread Wheat (*Triticum aestivum* L.) cultivars under salinity stress. Alex. Sci. Exch. J., 38 (2): 259-270.

Hassan, H.Kh. and F. Hassan (1994). Response of some wheat cultivars to sowing methods under saline irrigation water. Annals Agric. Sci. Ain Shams Univ., 30 (1):167-176.

Hassan, Kh.H., M.A. Attia and A.M.M. Abdel-Kariem (2014). Effect of wheat sowing rates intercropped with Alfalfa on forage and grain yields under saline conditions at Siwa Oasis, Egypt. Egypt. J. Appl. Sci., 29 (6): 189-203.

Iqtidar, H., M.A. Khan and H. Khan (2010). Effect of seed rates on the agro-physiological traits of wheat. Sarhad J. Agric., 26 (2): 169-176.

Javed, I., A. Zobaib, M. Hussain, A. Bashir, M. Hamza, W. Muzaffers, M.T. Latif and N. Faisal (2020). Effect of seed rate on yield components and grain yield of ridge sown

wheat varieties. Pak. J. Agric. Res., 33 (3): 508-515.

MALR (2014). Ministry of Agriculture and Land Reclamation. Bulletins of Agricultural Statistics No. 1 Arab Republic of Egypt, Minist. Agric. and Land Reclamation, Egypt. Econ. Affairs Sector, Dokki, Egypt.

Munns, R., R.A. James and A. Läuchli (2006). Approaches to increasing the salt tolerance of wheat and other cereals. J. Exp. Bot., 57 (5): 1025-1043.

Ozturk, A., O. Caglar and S. Bulut (2006). Growth and Yield Response of Facultative Wheat to Winter Sowing, Freezing Sowing and Spring Sowing at Different Seeding Rates. J. Agron. and Crop Sci., 192 (1): 10-16.

Rafique, S.M., M. Rashid, M.M. Akram, J. Ahmad, R. Hussain and A. Razzaq (2010). Optimum seed rate of wheat in available soil moisture under rainfed conditions. J. Agric. Res., 47 (2):143-151.

Roser, M. and E. Ortiz-Ospina (2017). World population growth vol. 2017: Our World In Data.org. (Retrieved: https://ourworldindata. org/ world-population-growth/)

Shalaldeh, G. and T. Thalji (2007). Impacts of plant population on wheat and barley genotypes under salinity conditions. J. Agron., 6 (1):119-124.

Soomro, U.A., U.R. Mujeeb, A.O. Ejaz, G. Shereen and T. Abdul Qadir (2009). Effects of Sowing Method and Seed Rate on Growth and Yield of Wheat (*Triticum aestivum* L.). World J. Agric. Sci., 5 (2): 159-162

Steel, R.G.O., J.H. Torrie and Dickey (1997). Principles and Procedures of Statistics. Biometrical Approach 3rd Ed. Mc Grow-Hill, New Yourk, USA.

Tadesse, A., T. Yoseph and M. Mitiku (2017). Effect of sowing methods and seed rate on yield of bread wheat (*Triticum aestivum* L.) at south ari district, south Omo zone, Snnpr, Ethiopia. Int. J. Res., Granthaalayah, 5 (6): 175-180.

Tao Z.Q., D.M. Wang, S.K. Ma, Y.S. Yang, G.C. Zhao and X.H. Chang (2018). Light interception and radiation use efficiency response tridimensional uniform sowing in winter wheat. J. Integrative Agric., 17 (3): 566-578.

Tesfaye, G. (2015). Seed Rate and Sowing Method Effects on Seed Quality of Bread Wheat (*Triticum aestivum* L.) Varieties in Horo District, Western Ethiopia. Res. Article Malays. J. Med. Biol. Res., 2 (3):273-283.

## إستجابة بعض أصناف القمح لطرق الزراعة ومعدلات التقاوي تحت ظروف واحة سيوة

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أقيمت تجربتان حقليتان بمحطة بحوث سيوه – مركز بحوث الصحراء خلال موسمي 2017/2016 و 2018/2017 لدراسة تأثير طرق الزراعة و معدل التقاوي علي صنفي القمح سخا 94 و مصر2 و كان معدل التقاوي (30، 45 ، 60، 75 كجم /فدان) وطرق الزراعة في سطور و الزراعة بدار. وأشارت النتائج أن طريقة الزراعة في سطور أعطت أعلي إنتاجية لمحصول الحبوب عن طريقة الزراعة بدار في الموسم الأول والثاني بنسبة37.6% ، 12.5علي التوالي. ترجع الزيادة في إنتاجية الحبوب إلي زيادة عدد السنابل/م$^2$ و عدد الحبوب سنبلة و زيادة وزن 1000 حبة جرام. أعطي صنف مصر2 زيادة في المحصول البيولوجي ومحصول الحبوب ودليل الحصاد وعدد السنابل/م$^2$ في كلا الموسمين. بينما سجل الصنف سخا 94 زيادة في قيم عدد حبوب السنبلة ووزن 1000 حبة في كلا الموسمين، أشارت النتائج أن الزيادة في إنتاجية الحبوب و دليل الحصاد كان ملحوظا بمعدل التقاوي 45 ، 60 كجم/فدان في الموسمين علي التوالي. ودلت النتائج أن هناك زيادة تدريجية معنوية في عدد السنابل/م$^2$والمحصول البيولوجي كجم/ فدان مع زيادة معدل التقاوي من 30 – 75 كجم/فدان . بينما كان هناك نقص في وزن 1000 حبة مع زيادة معدلات التقاوى وبالتالي يمكن التوصية بزراعة صنف القمح مصر2 بمعدل تقاوى60 كجم/ فدان بطريقة الزراعة في سطور لإنتاج القمح تحت ظروف الملوحة في واحة سيوة.

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