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# EVALUATION OF SOME DURUM WHEAT CULTIVARS IN THE NEWLY RECLAIMED SANDY SOILS IN MIDDLE EGYPT

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## ABSTRACT

***A filed experiment was conducted in the newly reclaimed lands in El-Minia Governorate (Middle Egypt), Egypt, in the two successive winter growing seasons 2018/2019 and 2019/2020, this study aimed to find the durum wheat cultivars having high yielding potential and suitable for growing under newly reclaimed sandy soils to increase wheat the productivity in Middle Egypt in randomized complete blocks design with four replicates. The results showed that wheat cultivars Beni Sweif 7 and Beni Sweif 1 were the earliest cultivars in heading (116.5 and 102.5 days) in the first and second seasons, respectively. Beni Sweif 5 was earlier than the other cultivars in maturity (142.8 and 128 days) in both seasons. Beni Sweif 7 had the tallest plants (80.1 and 76.3 cm). Sohag 5 recorded the highest number of spikes m$^{-2}$ (330.2 and 360). The highest number of kernels spike$^{-1}$ (54.5 and 49.0 kernels), 1000-kernel weight (50.46 and 41.77gm), grain yield (19.03 and 16.28 ardab faddan$^{-1}$), biological yield (7.525 and 6.191 ton faddan$^{-1}$) and harvest index (37.90 and 39.23 %) were produced by Beni Sweif 1. Moreover, Beni Sweif 1 recorded the highest grain yield at as an average of the two seasons producing 17.65 ardab faddan$^{-1}$ followed by Sohag 5 (15.06 ardab faddan$^{-1}$) and Beni Sweif 7 (14.55 ardab faddan$^{-1}$) which were higher than the general mean of the seven durum wheat cultivars (14.54 ardab faddan$^{-1}$). Significant and positive correlations were found in the second season only between number of spikes m$^{-2}$ and days to heading, between grain yield and number of spikes m$^{-2}$, and between biological yield and number of spikes m$^{-2}$ and grain yield. Therefore, durum wheat cultivar Beni Sweif 1 followed by Sohag 5 and Beni Sweif 7 were the best performing by producing the highest grain yield and could be recommended to be grown under new land conditions in Middle Egypt.***

Key words: ***Triticum durum, Sandy soil, Yield, Yield components***

## INTRODUCTION

Wheat belongs to family *Poaceae* and is the main winter cereal crop in Egypt for more than 7000 years. Its area amounted to about 1.3 mil. ha (3.17 mil. faddan) in 2019/2020 growing season producing a total of 8.5 mil. ton with an average of 6.4 ton ha$^{-1}$ (17.85 ardab feddan$^{-1}$) (Economic Affairs Annual Report, 2020). It is cultivated in old and new lands in Middle Egypt. The majority of wheat area is located old land under surface irrigation and in new land under sprinkler or pivot irrigation.

Durum wheat (*Triticum durum* L.) currently represents 8-10% of wheat grown area and produced worldwide (FAOSTAT, 2018). However, it is grown in relatively small geographical areas where it often plays a major role in the food security of urban communities. The productivity of durum wheat is often limited by an array of abiotic stresses that affect a successful growth and a complete grain filling. Durum wheat semolina is usually used to make pasta, coscos and other products, but recently more other cereals have been used to partially replace it. Also, durum wheat importance can be attributed to numerous uses for human consumption such as bread and macaroni industry due to high protein and gluten contents (Makowska *et al* 2008). Varietal selection is of primary importance. Aslam *et al* (2003) reported that cultivated wheat varieties can be adapted to fairly broad range of climatic conditions and consequently have a wide regional distribution by significantly better examining different planting areas. Wheat varieties according to their adaptability potential in various environments need to be improved (Mukherjee and Dhiman 2012). Amin and Mohamed (2012) and Moustafa and El-Sawi (2014) reported that durum wheat cultivars differed in grain yield in two studied growing seasons under new land conditions.

Wheat cultivation was extended to the newly reclaimed lands to increase the production and overcome the gap between consumption and production. But wheat productivity in the newly reclaimed lands is below average the productivity of Delta and Nile valley because some regions in the newly reclaimed lands are affected by some adverse environmental stresses which affect plant growth and productivity such as limited water supply, low soil fertility and soil salinity.

Planting in the newly reclaimed lands especially in desert regions has many problems. The Egyptian Government started to increase the growing area *via* a big project aims to reclaim 1.5 million faddans all over the country, one of these regions is located at Middle Egypt including El-Minia Government (Global Agricultural Information Network Report 2016). New lands are characterized by low soil fertility, salt affected soils, low water holding capacity (as the soil structure is mainly sandy soils) and the underground water may contain high levels of salt. Other regions have other problematic types of soils as calcareous soils with high levels of calcium carbonate and high pH levels, these types of soils have also other problems as low availability of macro- and micro-nutrients especially nitrogen, phosphors and iron. The environmental conditions prevailing in the newly reclaimed lands, especially soil characteristics, need an accurate choice of wheat genotypes with high yield potential under the environmental stresses dominating at these regions.

Therefore, this study is aimed to find the durum wheat cultivars having high yielding potential and suitable for growing under newly reclaimed sandy soils to increase the wheat productivity in the Middle Egypt.

## MATERIALS AND METHODS

A filed experiment was conducted in the newly reclaimed lands at Mallawy, El-Minia Governorate, Egypt, (Middle Egypt) in the two successive seasons 2018/2019 and 2019/2020. Seven durum wheat cultivars (*Triticum durum* L.) were tested for their yield (Table 1).

**Table 1. Name, pedigree, selection history and origin of the studied durum wheat cultivars.**

| No. | Name | Pedigree and selection history | Origin |
|---|---|---|---|
| 1 | Beni Sweif 1 | Jo"s"/AA"s"//FG"s".<br>CD 9799-126M-1M-SY-0M-0SD. | Egypt |
| 2 | Beni Sweif 5 | Dipper-2/Bushen-3.<br>CDSS92B128-1M-0Y-0M-0Y-3B-0Y-0SD. | Egypt |
| 3 | Beni Sweif 6 | Boomer-21/Busca-3.<br>CDSS95-Y001185-8Y-0M-0Y-0B-1Y-0B-0SD. | Egypt |
| 4 | Beni Sweif 7 | CBC509CHILE//SOOTY_9/RASCON_37/9/USDA595/3/D67.3/RABI//CRA/4/ALO/5/HUI/YAV_1/6/ARDENTE/7/HUI/YAV79/8/POD_9.<br>CDSS02-Y01233T-0T0PB-0Y-0M-26Y-0Y-0SD. | Egypt |
| 5 | Sohag 4 | Ajaia-I6//Hora/Jro/3/Ga/4/Zar/S/Suok-7/6/Stot//Altar84/Aid.<br>CDSSB007785-0T0PY-0M-0Y-129Y-0M-0Y-IB-0SH. | Egypt |
| 6 | Sohag 5 | TRN//21563/AA/3/BD2080/4/BD2339/5/Rascon37//Tarro2//Rascon3/6/Auk/Gull//Green.<br>CDSS00B00364T-0T0PB-0B=2Y-0M-0Y-1B-0Y-0SH. | Egypt |
| 7 | Beni Sweif 4 | AINZEN1.<br>ICD88-II20-ABL-0TR-1BR-0TR-6AP-0AP-0SD. | Egypt |

### Soil Analysis

The soil mechanical and chemical analysis of the experimental sites are presented in Table (2) according to Jackson (1973).

**Table 2. Mechanical and chemical properties of a representative soil sample of the experimental sites.**

| Soil property | Value |
|---|---|
| **Sand%** | 92.3 |
| **Silt%** | 2.6 |
| **Clay%** | 5.1 |
| **Soil texture** | **Sandy** |
| **Organic matter %** | 0.25 |
| **Total N (%)** | 0.04 |
| **Soluble ions (meq/100g soil (1:5))** | |
| **$CO_3^-$** | -- |
| **$HCO_3^-$** | 0.72 |
| **$Cl^-$** | 19.34 |
| **$SO_4^=$** | 2.6 |
| **$Ca^{++}$** | 6.35 |
| **$Mg^{++}$** | 3.1 |
| **$Na^+$** | 12.34 |
| **$K^+$** | 0.6 |
| **EC (ds/m)(1:5)** | 2.47 |
| **pH(1:1)** | 7.97 |
| **$CaCO_3$%** | 35.97 |

Data of soil analyses showed that sand represents 92.3% of soil texture indicating that the experimental site is sandy soil which characterized by low holding capacity of irrigation water. Moreover, the soil fertility is very low where the organic matter is only 0.25%, total nitrogen is 0.04% and soluble ions of potassium is 0.6%. However, the analysis showed low value of EC (2.47 ds/m), indicated that type of soil is good for planting wheat. Calcium carbonate percentage was high (35.97%) indicating that the soil type is sandy calcareous soil and pH value was high (7.97), these two factors decreases the availability of phosphorus to the plants which affects absorption of other macro-nutrients especially nitrogen uptake leading to unbalanced plant nutrition. These characterizations may help in results interpretation.

The sowing date was on 15 of November in the two seasons, and harvested in 17 and 2 of April in the first and second seasons, respectively. The experimental design was a randomized complete block design (RCBD) with four replicates. The plot area was 4.8 $m^2$ (6 rows, 4 m long x 20 cm apart). Seeds were drilled at the rate of 70 kg $faddan^{-1}$. All recommended cultural practices for new land conditions were applied. Metrological data was given in Table (3).

**Table 3. Metrological data of temperature ºC in Mallawi Agricultural Research Station Farm at 15 days intervals starting from November 2018 to June 2020 during the two growing seasons of 2018/2019 and 2019/2020.**

| At 15 days period | Season 2018/2019 | | | Season 2019/2020 | | |
|---|---|---|---|---|---|---|
| | Temperature ºC | | | Temperature ºC | | |
| | Max. | Min. | Avg. | Max. | Min. | Avg. |
| 15 November | 27.72 | 13.71 | 20.71 | 26.32 | 11.75 | 19.04 |
| 1 December | 23.61 | 8.99 | 16.30 | 23.01 | 7.87 | 15.44 |
| 15 December | 23.08 | 6.97 | 15.03 | 22.10 | 6.56 | 14.33 |
| 1 January | 19.75 | 5.58 | 12.66 | 24.46 | 6.90 | 15.68 |
| 15 January | 20.29 | 6.00 | 13.15 | 22.57 | 5.47 | 14.02 |
| 1 February | 22.65 | 8.93 | 15.79 | 24.40 | 6.19 | 15.29 |
| 15 February | 21.32 | 6.59 | 13.96 | 24.81 | 9.03 | 16.92 |
| 1 March | 23.99 | 8.13 | 16.06 | 32.32 | 12.57 | 22.45 |
| 15 March | 25.95 | 9.57 | 17.76 | 24.23 | 10.35 | 17.29 |
| 1 April | 27.85 | 11.83 | 19.84 | 30.24 | 12.51 | 21.37 |
| 15 April | 31.48 | 14.54 | 23.01 | 32.45 | 15.90 | 24.18 |
| 1 May | 32.33 | 16.88 | 24.61 | 34.95 | 17.24 | 26.09 |
| 15 May | 35.19 | 18.55 | 26.87 | 34.07 | 19.07 | 26.57 |
| 1 June | 36.27 | 20.59 | 28.43 | 36.94 | 21.18 | 29.06 |

**Collected data included the following:**

**A- Agronomic characters:**

1- **Days to heading** were recorded when 50% of the heads were emerged from the boots in each plot.
2- **Days to maturity** were recorded when the top internodes were showing no green tissue in each plot.
3- **Plant height (cm)**: was estimated as average plant height in cm was recorded from ten randomly plants in each plot.

**B- Yield and yield components:**

1- **Number of spikes $m^{-2}$** was estimated as number of fertile spikes in a guarded square meter within each plot before harvesting.
2- **Number of kernels $spike^{-1}$** was estimated as an average number of grains from ten spikes randomly taken from each plot.
3- **1000-kernel weight (g)** was recorded as an average of two random samples of 1000 kernels from clean grains of each plot.
4- **Grain yield (ardab $faddan^{-1}$)** was estimated as the weight of grains of each plot, which was converted to ardab $faddan^{-1}$.
5- **Biological yield (ton $faddan^{-1}$)** was estimated as the total above ground parts of plants of each plot and converted to ton $faddan^{-1}$.
6- **Harvest index (%)** was estimated according to Hühn (1990).

$$\textbf{Harvest index} = \frac{\text{Grain yield (kg/plot)}}{\text{Biological yield (kg/plot)}} \times 100$$

**Statistical analysis**

All data of each season and combined data were statistically analyzed according to technique of analysis of variance (ANOVA) for the Randomized Complete Block design as mentioned by Gomez and Gomez (1984) by means of MSTAT-C program (1990) computer software package. The least significant differences (L.S.D.) at 5% level of probability were calculated to compare between treatment means and simple correlation coefficients amang all studied characters were calculated.

## RESULTS AND DISCUSSION

### Mean performance

### A- Agronomic characters

#### 1- Days to heading:

The data in Table (4) show that highly significant differences among all cultivars for days to heading in the two seasons. Cultivar Sohag 4 was the earliest in days to heading in the two seasons (Table 5) recording 111.8 and 96.0 days, respectively and when data were combined (103.9 days). Beni Sweif 5 and Beni Sweif 7 were the latest cultivars and recorded for combined data across seasons 108.7 days (Table 5). Number of days to heading in the second season was less than that in the first season. This finding is mainly due to high temperature dominated in Middle Egypt region at heading time (Table 3). The average increases of temperature in February and March were 1.23 and 2.96 $C^{\circ}$ which accelerated the physiological processes in wheat plants and decreased number of days to heading. Although the increase in temperature was only around two degrees but heat stress resulted in 14.2 days earlier in the second season than the first (114.1 vs. 99.9) in 2019/2020 (Table 5), indicating the sharp effects of abiotic stresses on plants. In that context, the variation in days to heading of different cultivars was also reported by Bhattarai *et al* (2017). The varietal differences in days to heading reflect different genetic makeup. Several researchers such as Mumtaz *et al* (2015), Kandil *et al* (2016), Hendawy (2017) and Raza *et al* (2018) observed varietal differences in most of growth characters.

#### 2-Days to maturity

Results in Table (4) included significant variance for days to maturity in both seasons and general mean was 137.9 days (Table 5). Beni

Sweif 5 was significantly the earliest cultivar in the two seasons (142.8 and 128.0 days) with an average was 135.4 days.

**Table 4. Analysis of variance for the studied traits for seven durum wheat cultivars in the two seasons of 2018/2019 and 2019/2020 and combined over two seasons.**

| Season | SOV | df | MS | | | |
|---|---|---|---|---|---|---|
| | | | Days to heading | Days to maturity | Plant height (cm) | No. spikes $m^{-2}$ |
| 2018/ 2020 | Replication | 3 | 7.56 | 9.083 | 53.571 | 689.286 |
| | Cultivars | 6 | 9.476** | 11.976** | 22.917 NS | 2097.619** |
| | Error | 18 | 3.032 | 4.389 | 23.71 | 730.952 |
| 2019/ 2020 | Replication | 3 | 27.667 | 2.000 | 191.369 | 290.476 |
| | Cultivars | 6 | 23.726* | 9.226* | 86.31* | 1993.75* |
| | Error | 18 | 6.028 | 3.306 | 37.897 | 678.671 |
| Combined analysis | Year (Y) | 1 | 3045.89 ** | 840.88 ** | 375.45 NS | 11144.64 ** |
| | Error | 6 | 17.61 | 5.54 | 122.47 | 489.88 |
| | Cultivars(C) | 6 | 26.20** | 14.20 ** | 72.32 NS | 3356.10 ** |
| | Y x C | 6 | 7.00 NS | 7.00NS | 36.91 NS | 735.27 NS |
| | Error | 36 | 4.53 | 3.85 | 30.80 | 704.81 |

| Season | SOV | df | MS | | | | |
|---|---|---|---|---|---|---|---|
| | | | No. kernels $spike^{-1}$ | 1000-kernel weight (g) | Grain yield (ardab $faddan^{-1}$) | Biological yield (ton $faddan^{-1}$) | Harvest index (%) |
| 2018/ 2019 | Replication | 3 | 22.417 | 12.272 | 3.101 | 0.459 | 2.076 |
| | Cultivars | 6 | 69.81** | 47.55** | 8.761* | 1.090* | 24.289** |
| | Error | 18 | 21.111 | 9.172 | 2.530 | 0.395 | 4.821 |
| 2019/ 2020 | Replication | 3 | 5.571 | 5.173 | 1.070 | 0.206 | 11.377 |
| | Cultivars | 6 | 56.071** | 18.48* | 11.059* | 1.334** | 7.828 NS |
| | Error | 18 | 11.627 | 5.576 | 3.670 | 0.305 | 12.989 |
| Combined analysis | Year (Y) | 1 | 355.02 ** | 746.06 ** | 111.33 ** | 31.367 ** | 48.12 * |
| | Error | 6 | 13.99 | 8.72 | 2.09 | 0.332 | 6.73 |
| | Cultivars(C) | 6 | 87.99 ** | 51.92 ** | 18.66 ** | 1.962 ** | 22.34 * |
| | Y x C | 6 | 37.89 NS | 14.11 NS | 1.16 NS | 0.461 NS | 10.32 NS |
| | Error | 36 | 16.37 | 7.37 | 3.10 | 0.350 | 8.90 |

***, ** = Significant at $p \leq 0.05$ and $\leq 0.01$ levels of probability, respectively. NS= Not significant**

In addition, Sohag 4 was the latest one and reached to maturity after 148 and 132.3 days from sowing in both seasons, respectively, with an average of 140.2 days. Higher temperature in April and May in 2020 (Table 3) decreased grain filling period and resulted in early maturity of wheat cultivars under investigation. Average temperature in April was 21.42 °C in 2019 while recorded 22.78 °C in 2020 and in May 2019 recorded 25.74 °C vs. 26.33 °C in 2020. These differences in temperature in the two years resulted in 14.8 days earlier in maturity in season 2020. Moreover, Araus *et al* (2007) stated that the number of days required for occurrence of different growth stage of wheat varied with cultivars. These results are in agreement with those reported by Tawfelis *et al* (2011) and Moustafa and El-Sawi (2014). Variation in days to maturity in different genotypes was also reported by Bayisa *et al* (2019).

**3- Plant height (cm)**

Plant height is mainly controlled by the genetic makeup of a genotype, but it is also affected by environmental conditions. Results in Table (4) indicated that mean squares for plant height were significant in second season only. The results in Table (5) indicated that Beni Sweif 7 had the tallest plants (80.1cm) without significant differences with other cultivars in the first season. In the second season, Beni Sweif 7 recorded the tallest plants (76.3 cm) followed by cultivars Sohag 4 (75 cm), Beni Sweif 4 (75 cm), Beni Sweif 5 (73.8 cm), Sohag 5 (72.5 cm) and Beni Sweif 1 (71.3 cm) but with insignificant differences. However, the shortest plants were produced by Beni Sweif 6 (62.5 cm) in the second season with an average of 68.7 cm. Also, Beni Sweif 7 recorded the tallest plant at the level of the average of the two seasons producing 78.2 cm which was higher than the general mean of the seven durum wheat cultivars (74.9 cm) as shown in Table (5). However, plant height of the seven cultivars decreased in the second year due to higher temperature dominated the region during the growing season (77.5 cm vs. 72.7 cm) in 2019/2020 (Table 5).

**Table 5. Means of days to heading, days to maturity and plant height (cm) for seven durum wheat cultivars in the two seasons of 2018/2019 and 2019/2020.**

| Cultivars | Days to heading | | | Days to maturity | | | Plant height (cm) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2018/19 | 2019/20 | Comb. | 2018/19 | 2019/20 | Comb. | 2018/19 | 2019/20 | Comb. |
| Beni Sweif 1 | 114.0 ab | 102.5 a | 108.3 | 143.5 b | 132.0 a | 137.8 | 78.8 a | 71.3 ab | 75.1 |
| Beni Sweif 5 | 115.8 a | 101.5 a | 108.7 | 142.8 b | 128.0 b | 135.4 | 75.0 a | 73.8 a | 74.4 |
| Beni Sweif 6 | 114.8 a | 100.8 ab | 107.8 | 144.8 ab | 130.8 ab | 137.8 | 74.9 a | 62.5 b | 68.7 |
| Beni Sweif 7 | 116.5 a | 100.8 ab | 108.7 | 145.8 ab | 130.0 ab | 139.0 | 80.1 a | 76.3 a | 78.2 |
| Sohag 4 | 111.8 b | 96.0 c | 103.9 | 148.0 a | 132.3 a | 140.2 | 75.0 a | 75.0 a | 75.0 |
| Sohag 5 | 115.5 a | 101.0 a | 108.3 | 145.5 ab | 131.0 ab | 138.3 | 80.0 a | 72.5 a | 76.3 |
| Beni Sweif 4 | 114.5 a | 97.0 bc | 105.8 | 146.0 ab | 128.5 b | 136.8 | 78.8 a | 75.0 a | 76.9 |
| Mean | 114.1 | 99.9 | 107.1 | 145.2 | 130.4 | 137.9 | 77.5 | 72.7 | 74.9 |
| LSD 5% | 2.59 | 3.65 | NS | 3.11 | 2.70 | NS | NS | 9.15 | NS |

**Comb. = Combined.**
**NS= Not significant**

These findings may be due to the optimum temperature in the first season and plants were passing through favorable conditions and had longer vegetative growth period, which gave plants opportunity to build more tissues and increase in height compared to high temperature in the second season (Table 3), resulting in shorter plants. These results are in harmony with those reported by Gafaar (2007), Rahman *et al* (2010) and Bayisa *et al* (2019).

## B- Yield and yield components

### 1- Number of spikes $m^{-2}$

The analysis of variance in Table (4) showed significant differences amen seasons. Cultivars, also, differed between each other in number of spikes $m^{-2}$. Sohag 5 gave the highest number of 360.0 and 330.2 spikes in the first and second seasons, respectively with an average of 345.1 spikes $m^{-2}$. On the other hand, Sohag 4 gave the lowest number (300.0 and 267.3 spikes) in the first and the second seasons, respectively, and the average was 283.7 spikes (Table 6).

**Table 6. Means of No. of spikes m$^{-2}$, No. of kernels spike$^{-1}$ and 1000-kernel weight (g) for seven durum wheat cultivars in the two of seasons 2018/2019 and 2019/2020.**

| Cultivars | No. of spikes m$^{-2}$ | | | No. of kernels spike$^{-1}$ | | | 1000-Kernel weight (g) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2018/19 | 2019/20 | Comb. | 2018/19 | 2019/20 | Comb. | 2018/19 | 2019/20 | Comb. |
| Beni Sweif 1 | 325.0 a-c | 330.0 a | 327.5 | 54.50 a | 49.0 a | 51.8 | 50.46 a | 41.77 a | 46.12 |
| Beni Sweif 5 | 307.5 bc | 293.8 ab | 300.7 | 46.25 bc | 48.3 a | 47.3 | 48.48 a | 41.04 a | 44.76 |
| Beni Sweif 6 | 345.0 ab | 316.3 a | 330.7 | 44.00 c | 40.8 b | 42.4 | 48.09 a | 40.13 ab | 44.11 |
| Beni Sweif 7 | 352.5 a | 300.0 ab | 326.3 | 46.00 bc | 42.8 b | 44.4 | 48.85 a | 36.83 bc | 42.84 |
| Sohag 4 | 300.0 c | 267.3 b | 283.7 | 52.75 ab | 41.3 b | 47.0 | 46.72 ab | 40.66 a | 43.69 |
| Sohag 5 | 360.0 a | 330.2 a | 345.1 | 53.25 ab | 48.5 a | 50.9 | 40.76 c | 36.17 c | 38.46 |
| Beni Sweif 4 | 342.5 a-c | 297.5 ab | 320.0 | 51.00 a-c | 42.0 b | 46.5 | 43.22 bc | 38.88 a-c | 41.05 |
| Mean | 357.7 | 305.0 | 331.4 | 53.20 | 44.64 | 47.2 | 46.65 | 39.35 | 43.00 |
| LSD 5% | 40.16 | 38.70 | NS | 6.83 | 5.07 | NS | 4.50 | 3.51 | NS |

**Comb. = Combined.**
**NS= Not significant**

The average number of spikes m$^{-2}$ for the seven durum wheat cultivars in season 2018/2019 was (357.7 spikes m$^{-2}$) which in 2019/2020 decreased to 305 spikes m$^{-2}$. These results indicate that this character was affected by high temperature dominated the region at tillering time and produced less number of spikes in 2019/2020 than in 2018/2019. In that respect, Harper *et al* (1987) reported that different number of spikes per unit area is a result of the ability differences of cultivars to produce fertile tillers. It could be concluded that marked genetically differences existed among the seven evaluated cultivars. This result was in harmony with that reported by Moustafa and El-Sawi (2014). Previous researchers such as Kandil *et al* (2016), Hendawy (2017) and Raza *et al* (2018) found also varietal differences in yield and its attributes.

**2- Number of kernels spike$^{-1}$**

Number of kernels spike$^{-1}$ is a very important parameter contributing toward grain yield. Number of kernels per spike depends on the length of the spike and spikelet fertility. It is determined by genetic makeup and environmental factors prevailing during the growth period. It has a direct contribution to the final grain yield in wheat and varies with growing conditions. Results in Table (4) showed that the ANOVA for number of kernels spike$^{-1}$ was highly significant in both seasons. Data in Table 6 showed that wheat cultivars significantly differed in the No. of kernels spike$^{-1}$ in both seasons. The highest number were (54.50 and 49.0) produced by wheat cultivar Beni Sweif 1 with an average of 51.8 kernels. However, wheat cultivar Beni Sweif 6 gave the lowest No. of kernels spike$^{-1}$ (44 and 40.8) in the first and second seasons, respectively, with an average of 42.4 kernels. The average number of kernels spike$^{-1}$ for the seven cultivars in first season was 53.20 kernels while in the second season it was decreased to 44.64 kernels. These results indicate that this character was affected by high temperature and produced less kernels number in the second season than the first season. Also, the present findings may explain the genetic variability among studied cultivars and response of each one to environmental conditions during growing season. The behavior of genotypes could be attributed to their different genetic system. These results are similar to those of Tawfelis *et al* (2010) and Bhattarai *et al* (2017) who reported significant variations among cultivars for number of kernels per spike.

**3- 1000-kernel weight**

This is a very important character of wheat as a yield component. The analysis of variance in Table (4) showed significant differences among genotypes in both seasons. The averages of 1000-kernel weight (g) are shown in Table (6) the highest value of 1000-kernel weight (50.46 and 41.77 g) in the first and second seasons, respectively. Also, the average

(46.12 g) was produced from wheat cultivar Beni Sweif 1. While, the lowest value each season (40.76 and 36.17 g) or the average (38.46 g) was obtained from wheat cultivar Sohag 5. The superiority of wheat cultivar Beni Sweif 1 in weight of 1000-kernel may be attributed to gave the highest number of kernels spike$^{-1}$ and kernels weight spike$^{-1}$. These results are similar to those of Hesham and Gomaa (2017). The superiority of these cultivars might have been resulted from its better growth and all or some yield attributes. Varietal differences in yield and its attributes were also found by previous researchers such as Kandil *et al* (2016), Hendawy (2017) and El Sayed *et al* (2018).

**4- Grain yield (ardab faddan$^{-1}$)**

The main target of this investigation was to evaluate the seven durum wheat cultivars for their yield potential in a sandy soil. Data in Table (4) indicated that the mean squares due to grain yield in (ardab faddan$^{-1}$) was significant and affected by different wheat cultivars in both seasons. It could be observed that the highest grain yield was produced by Beni Sweif 1 as compared to the other cultivars, in the two growing seasons. The maximum grain yields (19.03 and 16.28 ardab faddan$^{-1}$) were obtained by Beni Sweif 1, whereas, Sohag 4 produced the lowest grain yield (14.66 and 11.25 ardab faddan$^{-1}$) in the first and second seasons, respectively, and recorded an average of 12.95 ardab faddan$^{-1}$. Besides Beni Sweif 1 recorded the highest grain yield at the level of the average of the two seasons producing 17.65 ardab faddan$^{-1}$ followed by Sohag 5 (15.06 ardab faddan$^{-1}$) and Beni Sweif 7 (14.55 ardab faddan$^{-1}$) which was higher than the general mean of the seven wheat cultivars (14.54 ardab faddan$^{-1}$) as shown in Table (7). Therefore, these results indicated superiority in grain yield and the adaptability of Beni Sweif 1 followed by Beni Sweif 7 and Sohag 5 under the newly reclaimed lands at El-Minia governorate. It is worthy to mention that the decrease in grain yield in the second season comparing with the first one is due to the relatively higher air temperature occurred late in the season during grain filling period (Table 3). Jagadish (2012), found that higher temperature caused significant reduction in the final grain weight and decreases in yield components as compared to optimum temperature. Escaping heat stress had been the major strategy to develop high temperature tolerant genotypes. Therefore, breeders focus on crop improvement to develop short duration varieties for high temperature environments. Also, the cultivar differences in grain yield may be attributed to gentical factors and environment conditions which effected on yield attributes and the highest number of kernels/spike and 1000-kernel weight produced by Beni Sweif 1 (Table 6). These results are in harmony with those reported by Moustafa and El-Sawi (2014), Zeleke *et al* (2019) and Mehmet (2020).

**5- Biological yield (ton faddan$^{-1}$)**

The cultivars differed significantly in their biological yield in the two seasons (Table 4). The cultivar Beni Sweif 1 produced the highest biological yield. It recorded 7.525 and 6.191 ton faddan$^{-1}$ in first and second seasons, respectively. While, Beni Sweif 5 had the lowest biological yield and recorded 6.081 ton faddan$^{-1}$ in first season and Sohag 4 recorded 4.681 ton faddan$^{-1}$ in the second season. Moreover, Beni Sweif 1 recorded the highest biological yield at the level of the average of the two seasons producing 6.858 ton faddan$^{-1}$ followed by Beni Sweif 7 (6.267 ton faddan$^{-1}$), Beni Sweif 6 (6.245 ton faddan$^{-1}$) and Sohag 5 (6.212 ton faddan$^{-1}$) which was higher than the general mean of the seven wheat cultivars (6.073 ton faddan$^{-1}$) as shown in Table (7). These results may be due to the shortest plants and least No of spikes m$^{-2}$ of Beni Sweif 5 and Sohag 4, which could be reflected on reducing its biological yield. This suggests that selection for high biomass and harvest index is efficient to ensure high nutrients uptake especially N and translocation to the grains. These differences between cultivars could be referred to their genetic constitutions and their interaction with the prevailing environmental conditions. These results are in agreement with those reported by Thanaa and El-Hussin (2013) and Raza *et al* (2018).

**Table 7. Means of grain yield (ardab faddan$^{-1}$), biological yield (ton faddan$^{-1}$) and harvest index for seven durum wheat cultivars in the two seasons of 2018/2019 and 2019/2020.**

| Cultivars | Grain yield (ardab faddan$^{-1}$) | | | Biological yield (ton faddan$^{-1}$) | | | Harvest index (%) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2018/19 | 2019/20 | Comb. | 2018/19 | 2019/20 | Comb. | 2018/19 | 2019/20 | Comb. |
| Beni Sweif 1 | 19.03 a | 16.28 a | 17.65 | 7.525 a | 6.191 a | 6.858 | 37.90 a | 39.23 a | 38.57 |
| Beni Sweif 5 | 15.53 b | 11.68 b | 13.60 | 6.081 c | 4.703 c | 5.392 | 38.39 a | 37.19 a | 37.79 |
| Beni Sweif 6 | 14.80 b | 13.13 b | 13.96 | 6.803 a-c | 5.688 ab | 6.245 | 32.55 c | 34.91 a | 33.73 |
| Beni Sweif 7 | 16.19 b | 12.91 b | 14.55 | 7.394 ab | 5.141 bc | 6.267 | 32.94 c | 37.94 a | 35.44 |
| Sohag 4 | 14.66 b | 11.25 b | 12.95 | 6.366 bc | 4.681 c | 5.523 | 34.47 bc | 36.20 a | 35.34 |
| Sohag 5 | 16.12 b | 14.00 ab | 15.06 | 6.628 a-c | 5.797 ab | 6.212 | 36.56 ab | 36.14 a | 36.35 |
| Beni Sweif 4 | 15.31 b | 12.66 b | 13.98 | 6.956 a-c | 5.075 bc | 6.015 | 33.02 c | 37.31 a | 35.17 |
| Mean | 15.95 | 13.13 | 14.54 | 6.822 | 5.325 | 6.073 | 35.10 | 37.00 | 36.05 |
| LSD 5% | 3.363 | 2.846 | 0.464 | 0.934 | 0.820 | NS | 3.262 | NS | NS |

**Comb. = Combined**
**NS = Not significant**

### 6- Harvest index (%)

The relationship between total biological yields of a crop was expressed in term of harvest index which ultimately determines the ability of converting the dry matter into economic yield. Harvest index (HI) has been used to describe the proportion of harvestable biomass. Hence it is more efficient when this cultivar was selected so as to promote the harvest index. Alagarswany and Seetharama (1982) reported that biomass and harvest index could be used as indicators of nutrients uptake and translocation to the grain in different genotypes. Selection for high biomass and harvest index is sufficient to ensure high nutrients uptake and translocation of assimilate to the spike. The analysis of variance pertaining to harvest index for the different cultivars are given in Table (4) where results indicated that mean squares for harvest index was highly significant in the first season only. The harvest index of the cultivars ranged from 32.55% to 37.90% with an average value of 35.10% in the first season and ranged from 33.73% to 38.57% with an average of 37% in the second season (Table 7). The highest harvest index was recorded from Beni Sweif 1 (37.90, 39.23 and an average of 38.57 % in the first and second season, respectively). On the other hand, the least harvest index was recorded by Beni Sweif 6 (32.55, 34.91 and an average of 33.73% was obtained in the first and second seasons, respectively). This result is in harmony with that reported by Moustafa (2014) in the first season and Moustafa and El-Sawi (2014) in the second season.

**Correlation coefficients**

Grain yield of wheat is a complex trait which is affected by different components such us plant height, number of spikes $m^{-2}$, number of kernels $spike^{-1}$, 1000-kerenel weight, and biological yield. Correlation coefficient for different traits is present in Table (8). The result of correlation showed that number of spikes $m^{-2}$ was the most important yield component that has significant contribution in grain yield, especially under terminal heat stress environment. Number of spikes $m^{-2}$ showed positive and significant correlation with days to heading which had indicated simultaneous improvement of these traits is possible. Biological yield had highly significant and positive correlation with number of spikes $m^{-2}$ and grain yield. These results are in accordance with those found by Tahir *et al* (2006) and Abdelmula et al. (2010). Also, the strong correlation between yield and its components was reported by Awadalla *et al* (2011).

**Table 8. Correlation coefficients among days to heading (DH), days to maturity (DM), plant height (PH), number of spikes m$^{-2}$ (NSM$^{-2}$), number of kernels spike$^{-2}$ (NKS$^{-1}$), 1000-kernel weight (TKW), grain yield (GY), biological yield (BY) and harvest index (HI) in the first season (above diagonal) and in the second season (below diagonal).**

| Traits | DH | DM | PH | NSM$^{-2}$ | NKS$^{-1}$ | TKW | GY | BY | HI |
|---|---|---|---|---|---|---|---|---|---|
| DH | | -0.538 | 0.012 | 0.622 | -0.527 | -0.030 | 0.135 | 0.191 | 0.037 |
| DM | 0.001 | | 0.303 | 0.020 | 0.264 | -0.441 | -0.497 | -0.053 | -0.619 |
| PH | 0.232 | -0.029 | | -0.199 | 0.375 | -0.177 | 0.077 | -0.019 | 0.160 |
| NSM$^{-2}$ | 0.760* | -0.134 | 0.517 | | -0.145 | -0.446 | 0.089 | 0.492 | -0.408 |
| NKS$^{-1}$ | 0.682 | -0.017 | 0.302 | 0.553 | | -0.342 | 0.477 | 0.154 | 0.411 |
| TKW | 0.009 | 0.171 | -0.689 | -0.219 | 0.060 | | 0.358 | 0.297 | 0.138 |
| GY | 0.631 | 0.383 | 0.557 | 0.862** | 0.533 | 0.033 | | 0. 670 | 0.557 |
| BY | 0.612 | 0.444 | 0.451 | 0.924** | 0.395 | -0.058 | 0.939** | | -0.239 |
| HI | 0.314 | -0.038 | 0.504 | 0.638 | 0.489 | 0.181 | 0.512 | 0.188 | |

***, ** = Significant at $p \leq 0.05$ and $\leq 0.01$ levels of probability, respectively.**

## CONCLUSION

The results suggest that the cultivar Beni Sweif 1 followed by Sohag 5 and Beni Sweif 7 showed high-productivity under sandy soils of El-Minia Governorate conditions.

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# تقييم بعض أصناف قمح المكرونة في الأراضي الرملية حديثة الأستصلاح بمنطقة مصر الوسطى

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***أقيمت تجربتان حقليتان في مركز ملوى بالأراضى الجديدة فى محافظة المنيا (مصر الوسطى) خلال موسمي النمو ٢٠١٩/٢٠١٨ و٢٠٢٠/٢٠١٩م. لتقييم سبعة أصناف من قمح المكرونة تحت ظروف الأراضى الجديدة بمحافظة المنيا. وقد أستخدم في هذه الدراسة تصميم القطاعات الكاملة العشوائية في أربعة مكرارات وبينت النتائج أن الصنفين بنى سويف ٧ وبنى سويف ١ أبكر الأصناف فى طرد السنابل (١١٦,٥ و ١٠٢,٥ يوم) فى السنة الأولى والسنة الثانية على التوالى. والصنف بنى سويف ٥ كان أبكر الأصناف فى النضج عن باقى الأصناف (١٤٢,٨ و ١٢٨ يوم) فى الموسمين. وأعطى الصنف بنى سويف ٧ أطول النباتات (٧٦,٣ و ٨٠,١ سم). والصنف سوهاج ٥ سجل أعلى عدد من السنابل فى المتر المربع (٣٣٠,٢ و ٣٦٠ سنبله). وسجل الصنف بنى سويف ١ أعلى الأصناف فى صفات عدد حبوب السنبله (٥٤,٥ و٤٩,٠حبه) ووزن ١٠٠٠حبه (٥٠,٤٦ و ٤١,٧٧ جم) ومحصول الحبوب (١٩,٠٣ و ١٦,٢٨ أردب للفدان) والمحصول البيولوجى (٧,٥٢٥ و ٦,١٩١ طن للفدان) ودليل الحصاد (٣٧,٩٠ و ٣٩,٢٣%)، علاوة على ذلك سجل الصنف بنى سويف ١ أعلى محصول حبوب لمتوسط الموسميين (١٧,٦٥ أردب للفدان) متبوع بالصنفين سوهاج ٥ و بنى سويف ٧ (١٥,٠٦ و ١٤,٥٥ أردب للفدان على التوالى) حيث سجلوا أعلى من المتوسط العام للأصناف السبعة (١٤,٥٤ أردب للفدان). و أظهرت النتائج أن هناك إرتباط معنوى موجب في السنة الثانية فقط بين كل من صفة عدد السنابل في المتر المربع وعدد الأيام حتى التزهير، كذلك صفة محصول الحبوب مع عدد السنابل في المتر المربع وأيضاً صفة المحصول البيولوجى مع عدد السنابل في المتر المربع ومحصول الحبوب.و لذلك بينت الدراسة أن صنف قمح المكرونة بنى سويف ١ متبوع بالصنفين سوهاج ٥ وبنى سويف ٧ سجلوا أعلى إنتاجية من محصول الحبوب ويمكن التوصية بزراعتهم تحت ظروف الأراضى الجديدة بمصر الوسطى.***

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