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RESEARCH ARTICLE

Effects of seeding rates and nitrogen fertilizer levels on the productivity of some bread wheat genotypes in new lands under Sinai and upper Egypt conditions

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Abstract

To determine the effects of different seeding rates and nitrogen fertilizer levels on yield and its components of six bread wheat genotypes, a field experiment was conducted at East Canal and Al Marashda Agricultural Research Stations during the 2018-2019 and 2019-2020 growing seasons. The experiment was laid out in a split-split plot arrangement in a Randomized Complete Block Design with three replications. Seeding rates (60, 80, and 100 kg fad. $^{-1}$) were placed in the main plots, while nitrogen fertilizer levels (75,100 and 125 kg N fad. $^{-1}$) were allotted in the subplots, whereas, the sub-sub plots were allocated to the bread wheat genotypes (Gemmeiza 12, Sids 14, Shandaweel 1, Line 1, Line 2 and Line 3). The number of spikes m^{-2}, 1000 kernels weight, and grain yield were significantly higher at a seeding rate of 100 kg fad. $^{-1}$ as compared to other seeding rates. Nitrogen fertilizer levels affected significantly yield and its components. Grain yield and its components increased with each increment in nitrogen fertilizer level from 75 to 100 and up to 125 kg N fad^{-1}. Wheat is sown at a seeding rate of 100 kg fad. $^{-1}$ with 125 kg N fad. $^{-1}$ gave the highest number of spikes m^{-2} and grain yield. The interaction effects of seeding rate by genotypes and nitrogen levels by genotypes reveal the superiority of Sids 14 and Shandaweel 1 wheat cultivars in grain yield when sown at a seeding rate of 100 kg fad. $^{-1}$ with 125 kg N fad. $^{-1}$ in both locations.

Keywords: Nitrogen fertilizer; Seeding rates; Wheat.

1. Introduction

Wheat (*Triticum aestivum* L.) is the most important cereal crops all over the world and it is considered the first food cereal crop is grown in Egypt. About 3.4 million faddans (equivalent to 1.42 million hectares) were planted with wheat in the 2019/2020 cropping year, slightly more than 3.27 million faddans (1.37 million hectares) planting in the previous year. The local total production area is about 9 million tons of wheat grains with an average of 19.19 ardab/faddan (6.85 ton/ha) (Economic Affaira Sector, 2021). Egypt remains the largest world's wheat importer. Wheat imports were about 13 million tons (FAO, 2020). Wheat national production is relatively lower than the consumption demands. Improving wheat production through increasing the productivity per unite area is the most important target to reduce the gap between wheat production and annual local demands. Increasing wheat production could be possible through increasing the wheat cultivated area and releasing high-yielding cultivars adapted to the Egyptian environments coupled with improved agronomic practices such as seeding rate and nitrogen fertilizer application. Therefore, efforts of the Egyptian government, with all its different sectors, should be directed toward increasing wheat cultivated area in newly reclaimed lands which will contribute significantly in revealing food security for the population from wheat and other crops.

The seeding rate has a significant influence on the grain yield of bread wheat (FAO, 2014).

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Bread wheat sowing at optimum seeding rate with appropriate fertilizer type would significantly enhance the number of grains per spike, the spike length, grain weight per spike, and thousand kernels weight and then finally produce high grain yield (Iqbal *et al.*, 2010). But, a seeding rates above or below the optimum may significantly reduce the yield (Ozturk *et al.*, 2006). Ashenafi (2000) reported that the seeding rate depends on the tillering capacity of the crop varieties, sowing date, soil conditions, and cultivation intensity. Gafaar (2007) found that increasing sowing density from 200 up to 400 plants per m^{-2} significantly increased grain yield. Seleiman *et al.* (2010) also noted that grain yield ha^{-1} of bread wheat was gradually and significantly increased as sowing density up to.

Nitrogen is an important macronutrient that plays a vital role in plant growth and it is considered the most important fertilizer needed for increasing yield in most field crops as well as wheat. The response of wheat to nitrogen levels is affected by many factors such as cultivars, soil, and preceding crops. Several studies stated that increasing nitrogen levels led to an increase in grain yield and its components (Ali *et al.*, 2011; Iqbal *et al.*, 2012; Enayat *et al.*, 2013; Youssef *et al.*, 2013; Ali *et al.*, 2016; Fadle *et al.*, 2016; Shah *et al.*, 2016). Abd El Hameed (2012) and Benin *et al.* (2012) found genetic variability for wheat cultivars in response to added levels of nitrogen fertilizer.

The objective of the present investigation was to study the performance of six bread wheat genotypes under different seeding rates and different levels of nitrogen to determine the best genotype at proper seeding rate and specific of nitrogen, in order to extend wheat cultivation in new lands with high yield wheat production.

2. Materials and methods

2.1. Sites characteristics

The two sites of the study (East Canal Agricultural Research Station, Saini, 30°48'13.1"N, 32°23'41.9"E, and Al Marashda Agricultural Research Station, Qena, 26° 05' 39.4"N, 32° 28' 57.2"E) are among the Egyptian government plan to reclaim 1.5 million faddans (630252 million ha) to increase the food security level for the growing population. Both locations have sandy soils which were characterized by low water holding capacity, low fertility and poor organic matter (Table 1). Therefore, the tested treatments are different from those in old lands and increased to higher levels. Moreover, weather conditions in the two sites are different from each other due to their locations as Sinai is located in the northeastern part of Egypt while the other site is located in the southwestern part of upper Egypt. The monthly maximum, minimum, and mean temperature from sowing date to harvest during the 2018-2019 and 2019-2020 seasons at two locations are summarized in (Table 2).

2.2. Experimental design and treatments

To determine the effects of different seeding rates and nitrogen levels on yield and its components of six bread wheat genotypes, a field experiment was conducted at the two previous locations during the 2018-2019 and 2019-2020 growing seasons. A split-split plot arrangement in Randomized Complete Block Design with three replications was used where, seeding rates (60, 80, and 100 kg fad. $^{-1}$) were placed in the main plots, while nitrogen fertilizer levels (75,100 and 125 kg N fad. $^{-1}$) were allotted in the subplots, whereas, the sub-sub plots were allocated to the bread wheat genotypes (Gemmeiza 12, Sids 14, Shandaweel 1, Line 1, Line 2 and Line 3). The pedigree and origin of the studied bread wheat genotypes are presented in (Table 3). The sub-sub plot area was 4.2 m^2 with 6 rows, 3.5m long and 20 cm apart. Nitrogen fertilizer in form of the ammonium nitrate (33.5%) was applied as six equal splits at sowing, 15 days after sowing, and four splits at every 15 days interval. All other cultural practices were applied as recommended. At harvest, two external rows from each plot were eliminated to avoid the border effect. Thus, four rows were harvested, threshed and their grain yield were weighted and adjusted to ardab per faddan. The other traits such as number of spikes m^{-2}, number of kernels $spike^{-1}$ and 1000 kernels weight (gm) were determined. Prior to sowing composite soil samples from the experimental areas up to 30 cm depth were collected and analyzed for physic-chemical characteristics. The physical and chemical properties of the experimental soils of the two locations are given in (Table 1).

2.3. Statistical analysis

The experimental data were statistically analyzed according to Gomez and Gomez (1984) by using GenStat 19th Ed. Statistical software. Means were compared using the least significant difference (L.S.D.) at 0.05 level of probability.

Table 1. The physical and chemical properties of the experimental soils of East Canal and Al Marashda Agricultural Research statins.

Property	Location	
	Canal East Agricultural Research Station	Al Marashda Agricultural Research Station
	Particle size distribution (%)	
Sand	92.02	87.7
Silt	3.78	6.9
Clay	4.2	5.4
Texture grade	Sandy	Sandy
Saturation percent (S.P) %	13.4	23
$CaCo_3$ (%)	1	7.8
PH (Soil paste)	7.86	8
E.C(dS mat 2°C)	0.49	0.31
	Soluble cations (meq L^{-1})	
Ca^+		0.65
Mg^{++}	2.64	0.45
Na^+	1.34	1.61
K^+	0.43	0.41
	Soluble anions (moq L^{-1})	
HCO_3^-	1.04	0.7
Cl^-	1.11	1.65
$So4^=$	2.26	0.77
Organic matter (%)	0.52	0.11

Table 2. Mean maximum and minimum air temperature © during the two growing seasons at East Canal and Al Marashda Agricultural Research statins.

Months	East Canal Agricultural Research Station						Al Marashda Agricultural Research Station					
	2018/2019			2019/2020			2018/2019			2019/2020		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
November	28.50	15.00	21.75	28.30	13.80	21.05	28.60	15.21	21.91	30.86	17.14	24.00
December	20.10	9.50	14.80	22.40	10.90	16.65	22.17	9.76	15.97	24.13	9.95	17.04
January	20.20	7.20	13.70	21.00	8.00	14.50	21.08	7.54	14.31	20.95	7.97	14.46
February	22.40	10.20	16.30	22.70	11.00	16.85	24.42	10.60	17.51	23.91	10.02	16.97
March	22.90	12.80	17.85	24.00	10.00	17.00	27.55	12.93	20.24	29.20	15.03	22.12
April	27.20	14.30	20.75	26.20	15.30	20.75	32.93	17.82	25.38	33.03	19.13	26.08

Table 3. The pedigree and origin of the six bread wheat genotypes used in this investigation.

No.	Genotypes	Pedigree and selection history	Origin
1	Gemmeiza 12	OTUS /3/ SARA / THB // VEE CMSS97Y002275-5Y-010M-010Y-010M-2Y-1M-0Y-0GM	Egypt
2	Sids 14	BOW "S" / VEE"S" // BOW"S" / TSI/3/ BANI SEWEF 1 SD293-1SD-2SD-4SD-0SD	Egypt
3	Shandaweel 1	SITE/MO/4/NAC/TH.AC//3*PVN/3/MIRLO/BUC. CMss93B005675-72Y-010M-010Y-010M-3Y-0M-0THY-0SH.	Egypt
4	Line 1	WHEATEAR/3/ATILA/2*PASTOR//FISCAL/6/YAR/AE.SQUAROSA (783)/4/GOV/AZ// MUS/3/SARA/5/MYNANUL//JUN ICW11-20050-1AP-0SD-0SD-3SD-0SD	ICARDA
5	Line 2	WBLLI//TEVEE/KAUZ/3/MILAN/SHA7//POTAM*3KS811261-5 ICW08-00279-24AP-0AP-040SD-6SD-0SD	ICARDA
6	Line 3	TRAP#1/BOW//PFAU/3/MILAN/4/ETBW4922/5/PFAU/MILAN ICW08-50404-6AP-0AP-0AP-5TR	ICARDA

3. Results and discussion

3.1. Effect of seeding rate

Data presented in (Tables 4 and 5) show the effects of seeding rates, nitrogen fertilizer levels and genotypes and their interactions on yield and its components of wheat at East Canal and Al Marashda Agricultural Research Stations during the two growing seasons.

Regarding the effects of seeding rates, the results revealed that increasing seeding rates had highly significant effects on yield and its components at the two locations in the two growing seasons. Increasing seeding rate from 60 to 80 and/or 100 kg seeds fad. $^{-1}$ was associated with significant increase in number of spikes m^{-2}, number of kernels spike^{-1}, 1000 kernels weight and grain yield. Wheat sown at seed rate of 100 Kg fad^{-1} significantly produced maximum number of spikes m-^{2} and grain yield at the two locations during the two growing seasons, number of kernels spike^{-1} at Al Marasha (loc. 2) in both growing seasons and 1000 kernels weight at the two locations in the 2019-2020 growing season. On the other hand, at East Canal location (loc. 1), seeding rate of 80 kg fad. $^{-1}$ produced the highest number of kernels spike^{-1} followed by 100 kg fad. $^{-1}$ during the two-growing season, whereas, lower seed rate of 60 kg fad. $^{-1}$ revealed remarkably least number kernels spike^{-1}. It was noticed that increasing seeding rate, the number of kernels spike^{-1} decreased Khan *et al.* (2002). These results are in agreement with those obtained by (Iqbal *et al.*, 2012; Said *et al.*, 2012; Abd El-Lattief, 2014; Nizamani *et al.*, 2014; El-Hag, 2016; Shah *et al.*, 2016; Mekomen, 2017; Mohiy and Salous, 2018) whom reported that grain yield and its components significantly differed according to different seeding rate. However, Baloch *et al.* (2010) and Eslami *et al.* (2014) found that increase in seed rate did not show any positive effects on 1000-grain weight and grain yield.

3.2. Effect of nitrogen levels

Results presented in (Tables 4 and 5) indicated that N fertilizer levels had highly significant influences on yield and its components at the two locations in the two growing seasons except number of spikes m^{-2} at East Canal location (loc.1) which was insignificant. Grain yield and its components increased with each increment in nitrogen fertilizer level from 75 to 100 and up to 125 kg N fad^{-1}. Maximum values of number of spikes m^{-2}, number of kernels spike^{-1}, 1000 kernels weight and grain yield in the two respective seasons were produced by applying 125 kg N fad. $^{-1}$, while minimum values were recorded with applying 75 kg N fad. $^{-1}$.

Table 4. Number of spikes m^{-2}, number of kernels $spike^{-1}$, 1000 kernel weight and grain yield ardab fed^{-1} affected by seeding rate, nitrogen fertilizer levels, genotypes and their interactions at the two locations as well as their combined during 2018/2019 growing season.

2018-2019 Season								
Seeding Rate (SR)	No. spikes m^{-2}		No. kernels $spike^{-1}$		1000 Kernels weight(gm)		Grain yield ardab fad. $^{-1}$	
	Loc. 1	Loc. 2	Loc. 1	Loc. 2	Loc. 1	Loc. 2	Loc. 1	Loc. 2
60 Kg fed^{-1}	199	233	35	41	48.48	32.37	8.5	9.69
80 Kg fed^{-1}	239	247	52	43	53.94	35.23	12.38	11.32
100 Kg fed^{-1}	281	257	47	46	53.81	38.61	13.74	13.27
F test	**	**	**	**	**	**	**	**
L.S.D. 0.05	15.17	9.14	0.87	1.14	1.7	1.13	0.53	1.28
N levels (N)	No. spikes m^{-2}		No. kernels $spike^{-1}$		1000 Kernels weight(gm)		Grain yield ardab fad. $^{-1}$	
	Loc. 1	Loc. 2	Loc. 1	Loc. 2	Loc. 1	Loc. 2	Loc. 1	Loc. 2
75 Kg fed^{-1}	226	222	41	41	51.31	33	10.04	9.2
100 Kg fed^{-1}	241	248	46	44	51.74	35.21	12.02	11.63
125 Kg fed^{-1}	252	267	48	46	53.18	38	12.57	13.46
F test	**	**	**	**	**	**	**	**
L.S.D. 0.05	5.73	6.85	1.27	1.25	0.9	0.77	0.42	1.36
Genotype (G)	No. spikes m^{-2}		No. kernels $spike^{-1}$		1000 Kernels weight(gm)		Grain yield ardab fad. $^{-1}$	
	Loc. 1	Loc. 2	Loc. 1	Loc. 2	Loc. 1	Loc. 2	Loc. 1	Loc. 2
Gemmeiza 12	229	227	45	43	54.62	36.17	12.54	10.93
Sids 14	245	248	49	40	55.13	38.81	12.58	11.9
Shandaweel 1	231	281	42	49	46.69	36.45	11.09	13.83
Line 1	245	254	45	41	48.85	32.98	10.39	11.08
Line 2	253	235	44	45	53.44	35.41	11.31	11.1
Line 3	235	229	44	41	53.74	32.6	11.35	9.75
F test	**	**	**	**	**	**	**	**
L.S.D. 0.05	8.36	8.51	1.65	1.43	1.27	1.55	0.67	0.99
Interaction								
SR*N	**	ns	*	ns	**	ns	**	ns
SR*G	ns	ns	*	ns	**	ns	ns	ns
N*G	ns	ns	*	ns	**	ns	ns	ns

Loc. 1= East Canal Agricultural Research Station Loc. 2= Al Marashda Agricultural Research Station
*, ** and ns indicate significant at 0.05 and 0.01level and insignificant of differences, respectively.

This increase could be attributed to the role played by nitrogen, as an important macronutrient, in enhancing plant growth and dry matter production through improved photosynthesis, which expressed in higher grain yield components, especially number of spikes m^{-2}, 1000 kernels weight and improved spikelet's fertility, resulting in increasing number of kernels $spike^{-1}$, and finally higher grain yield. These findings are agreed with those reported by (Ali *et al.*, 2011; Abd El Hameed, 2012; Iqbal *et al.*, 2012; Enayat *et al.*, 2013; Youssef *et al.*, 2013; Ali *et al.*, 2016; Fadle *et al.*, 2016; Shah *et al.*, 2016).

3.3. Effect of genotypes

Regarding wheat genotypes effects (Tables 4 and 5), the results revealed highly significant differences between yield and its components of the six bread wheat genotypes at the two locations during the two growing seasons. The results show the superiority of Sids 14, Line 2 at East Canal location (loc.1) and Shandaweel 1, Line 1 and Sids 14 at Al Marashda location (loc.2) for number of spikes m^{-2} in both growing seasons. Bread wheat cultivar Sids 14 was significantly superior to the other genotypes in number of kernels $spike^{-1}$ at loc. 1 in the two growing seasons and 1000 kernels weight in both locations during the two growing seasons, whereas, Shandaweel 1 evident better performance ($P<0.05$) in number of kernels $spike^{-1}$ at Al Marashda location (loc. 2). The two bread wheat cultivars Shandaweel 1 and Sids 14 gave the highest grain yield at the two locations during 2018-2019 and 2019-2020 growing seasons. These results indicated that Shandaweel 1 and Sids 14 cultivars are more adapted to the two locations. From the data in Table 3, it is noted that there is big difference in temperatures between the two locations in March (17.85 and 17 C° in East Canal site while it was 20.14 and 22.12 C° in Al Marashda location in the two seasons, respectively). High temperature during March in Al Marashda (Upper Egypt) accelerated grain filling and resulted in lower kernels weight which resulted in lower grain yield (Tables 4 and 5). The differences in yield and its components among the evaluated six bread wheat genotypes might be attributed to their genetic variability. Similar results were found by (Abd El Hameed, 2012; Nizamani *et al.*, 2014; Ali *et al.*, 2016; Fadle *et al.*, 2016; Mohiy and Salous, 2018).

3.4. Effect of interactions

The effects of the first order interactions i.e., seeding rate × nitrogen fertilizer levels, seeding rate × genotypes and nitrogen fertilizer levels × genotypes on yield and its components in the two growing seasons and their combined at the two locations are presented in (Tables 4 and 5).

The interaction between seeding rate and N fertilizer levels (SR × N), in (Tables 6 and 7), had highly significant effects on grain yield and its components at loc. 1 during the two growing seasons except number of spikes m^{-2} in the 2019-2020 growing season, whereas, it was insignificant for all studied traits at Al Marashda location (loc.2) in the both growing seasons. At East Canal location (loc.1), increasing seeding rate and nitrogen fertilizer levels increased number of spikes m^{-2} significantly which resulted in high increases in grain yield. However, rate of increase in number of kernels $spike^{-}$1 and 1000 kernels weight with increasing N fertilizer levels was higher at seed rate of 80 kg fad. $^{-1}$ and 60 kg fad. $^{-1}$ than 100 kg fad. $^{-1}$. Maximum number of spikes m^{-2} was recorded at seeding rate of 100 kg with 125 kg N fad. $^{-1}$, while, higher grain yield was noticed at seeding rate of 100 kg fad. $^{-1}$ with 125 kg N fad. $^{-1}$ but statistically similar to that of 100 kg N fad. $^{-1}$ in the 2018-2019 growing season. The highest number of kernels spike-1 and 1000 kernels weight were found at seeding rate of 80 kg fad. $^{-1}$ with 125 kg N fad. $^{-1}$. These results indicate that the great contribution of increasing grain yield was due to the increases in number of spikes m^{-2} more than the other two components. These results show the high tillering capacity of the new wheat cultivars as characterized by yield potential.

On the other hand, at Al Marashda location (loc. 2), it was noticed that grain yield and its components increased with each increase in seeding rate and nitrogen fertilizer level but it was insignificantly. The highest values of grain yield and its components were recorded at seeding rate 100 kg fad. $^{-1}$ with 125 kg N fad. $^{-1}$. The significant effects of nitrogen fertilization on spikes production fertilizer are also reported by (Fadle *et al.*, 2016).

Table 5. Number of spikes m^{-2}, number of kernels spike^{-1}, 1000 kernels weight and grain yield ardab fad.$^{-1}$ affected by seeding rate, nitrogen fertilizer levels, genotypes and their interactions at the two locations as well as their combined during 2019/2020 growing season.

2019-2020 Season								
Seeding Rate (SR)	No. spikes m^{-2}		No. kernels spike^{-1}		1000 Kernels weigh (gm)		Grain yield ardab fad.$^{-1}$	
	Loc. 1	Loc. 2	Loc. 1	Loc. 2	Loc. 1	Loc. 2	Loc. 1	Loc. 2
60 Kg fed^{-1}	169	256	42	48	53.36	38.15	11.48	10.76
80 Kg fed^{-1}	188	270	53	50	56.81	41.7	13.03	12.41
100 Kg fed^{-1}	195	282	50	53	58.59	45.68	14.84	13.97
F test	**	**	**	**	**	**	**	**
L.S.D. 0.05	7.57	8.75	1.11	1.66	1.98	1.52	0.25	1.1
N levels (N)	No. spikes m^{-2}		No. kernels spike^{-1}		1000 Kernels weigh (gm)		Grain yield ardab fad.$^{-1}$	
	Loc. 1	Loc. 2	Loc. 1	Loc. 2	Loc. 1	Loc. 2	Loc. 1	Loc. 2
75 Kg fed^{-1}	184	244	47	47	55.05	38.96	12.28	10.57
100 Kg fed^{-1}	185	272	49	51	56.46	41.71	13.25	12.49
125 Kg fed^{-1}	184	291	50	53	57.25	44.87	13.83	14.08
F test	Ns	**	**	**	**	**	**	**
L.S.D. 0.05	Ns	6.49	0.64	0.6	0.25	1.03	0.24	0.88
Genotype	No. spikes m^{-2}		No. kernels spike^{-1}		1000 Kernels weigh (gm)		Grain yield ardab fad.$^{-1}$	
(G)	Loc. 1	Loc. 2	Loc. 1	Loc. 2	Loc. 1	Loc. 2	Loc. 1	Loc. 2
Gemmeiza 12	188	250	50	50	58.33	42.73	13.75	11.84
Sids 14	196	269	53	48	59.94	45.78	14.09	12.94
Shandaweel 1	169	307	48	56	49.94	43.13	12.77	14.56
Line 1	180	279	49	47	52.24	38.99	12.49	11.76
Line 2	192	258	46	52	57.79	41.79	12.79	12.46
Line 3	180	251	47	49	59.27	38.64	12.83	10.74
F test	**	**	**	**	**	**	**	**
L.S.D. 0.05	8.06	14.49	1.72	1.91	0.84	1.55	0.65	1.09
Interaction								
SR*N	ns	ns	**	ns	**	ns	**	ns
SR*G	ns	ns	**	ns	**	ns	ns	ns
N*G	ns	ns	ns	ns	ns	ns	ns	ns

Loc. 1= East Canal Agricultural Research Station Loc. 2= Al Marashda Agricultural Research Station
*, ** and ns indicate significant at 0.05 and 0.01level and insignificant of differences, respectively.

Iqbal *et al.* (2012) found that significant interaction between seeding rate and nitrogen fertilizer levels for number of kernels spike^{-1} and grain yield and insignificant interaction for 1000 kernels weight, while, significant interaction between seeding rates and nitrogen fertilizer levels were reported by (Shah *et al.*, 2016) for yield and its component, pointing to, maximum values of yield and its components were at seed rate of 120 kg ha^{-1} with 120 kg N ha^{1}.

Table 6. Number of spikes m^{-2}, number of kernels $spike^{-1}$, 1000 kernels weight and grain yield ardab fad. $-^{1}$ as affected by seeding rate × N level (SR×N) interaction at the two locations during 2018/2019 growing season

2018-2019 Season									
Seeding rate (SR)	N levels (N)	No. spikes m^{-2}		No. kernels $spike^{-1}$		1000 Kernel weight (gm)		Grain yield (ardab/fad.)	
		Loc. 1	Loc. 2	Loc. 1	Loc. 2	Loc. 1	Loc. 2	Loc. 1	Loc. 2
60 Kg fed^{-1}	75 Kg fed^{-1}	200	211	32	38	47.37	30.14	7.46	7.57
	100 Kg fed^{-1}	196	235	35	42	47.66	32.19	8.37	9.8
	125 Kg fed^{-1}	201	254	39	44	50.42	34.79	9.67	11.7
80 Kg fed^{-1}	75 Kg fed^{-1}	224	224	48	41	52.32	32.81	10.96	8.9
	100 Kg fed^{-1}	240	250	54	43	52.96	35.09	12.94	11.47
	125 Kg fed^{-1}	253	268	55	45	56.56	37.79	13.23	13.6
100 Kg fed^{-1}	75 Kg fed^{-1}	254	232	44	43	54.26	36.05	11.69	11.14
	100 Kg fed^{-1}	287	259	48	46	54.61	38.36	14.73	13.62
	125 Kg fed^{-1}	302	279	49	48	52.57	41.41	14.81	15.06
L.S.D. 0.05		9.93	ns	2.19	ns	1.56	ns	0.73	ns

Table 7. Number of spikes m^{-2}, number of kernels $spike^{-1}$, 1000 kernels weight and grain yield ardab fad. $-^{1}$ as affected by seeding rate × N level (SR×N) interaction at the two locations during 2018/2019 growing season

2019-2020 Season									
Seeding rate (SR)	N levels (N)	No. spikes m^{-2}		No. kernels $spike^{-1}$		1000 Kernel weight (gm)		Grain yield (ardab/fad.)	
		Loc. 1	Loc. 2	Loc. 1	Loc. 2	Loc. 1	Loc. 2	Loc. 1	Loc. 2
60 Kg fed^{-1}	75 Kg fed^{-1}	173	232	42	45	52.67	35.34	11.14	8.53
	100 Kg fed^{-1}	171	257	43	49	53.26	38.13	11.54	10.72
	125 Kg fed^{-1}	164	277	42	50	54.15	40.99	11.77	13.04
80 Kg fed^{-1}	75 Kg fed^{-1}	186	246	51	47	54.46	38.81	12.14	10.43
	100 Kg fed^{-1}	188	274	52	52	57.16	41.56	13.09	12.63
	125 Kg fed^{-1}	191	289	57	53	58.82	44.73	13.87	14.17
100 Kg fed^{-1}	75 Kg fed^{-1}	194	255	49	50	58.03	42.72	13.55	12.76
	100 Kg fed^{-1}	194	284	50	54	58.96	45.43	15.14	14.13
	125 Kg fed^{-1}	198	307	51	55	58.79	48.88	15.84	15.02
L.S.D. 0.05		ns	ns	1.1	ns	0.43	ns	0.41	ns

The interaction effects of seeding rate by genotypes (SR × G), (Tables 8 and 9) had highly significant effects on number of kernels $pike^{-1}$ and 1000 kernels weight at East Canal location (loc. 1) in both growing seasons, whereas, it was insignificant for all the studied traits at Al Marashda location (loc. 2) during the two growing seasons. At East canal location (loc. 1), all the bread wheat genotypes exhibited insignificantly increase with increasing seeding rate from 60 kg fad^{-1} to 80 kg fad. $^{-1}$ up to 100 kg fad. $^{-1}$ for number of spikes m^{-2} and grain yield, whereas, these bread wheat genotypes showed significantly increase in number of kernels $spike^{-1}$ with increasing seeding rate from 60 kg fad. $^{-1}$ to 80 kg fad. $^{-1}$. On the other hand, increasing seeding rate up to 100 kg fad. $^{-1}$ increased grain yield and its components of the six bread wheat genotypes at Al Marashda location (loc. 2) during the two growing seasons, but it was insignificantly. Maximum number of spikes m^{-2} were recorded by Sids 14, Gemmeiza 12 and Line 1 at loc.1 in the 2018-2019 growing season, Line 2, Line 1 and Sids 14 at loc.1 in the 2019-2020 growing season and Shandaweel 1, Line 1 and Sids 14 at Al Marashda location in the two growing seasons when they sow at seed rate of 100 kg fad. $^{-1}$. The highest number of kernels spike^{-1} was obtained by the local bread wheat cultivar Sids 14 at East canal location during the two growing seasons when sown at seed rate of 80 kg fad. $^{-1}$, while, the local bread wheat cultivar Shandaweel 1 at Al Marashda location during the two growing seasons produced the highest number of kernels spike^{-1} when sown at seed rate of 80 kg fad. $^{-1}$ and 100 kg fad. $^{-1}$ without significant differences. The local bread wheat cultivar Sids 14 recorded the highest 1000 kernels weight at the two locations during the two growing seasons when sown at seed rate of 100 kg fad. $^{-1}$. The local bread wheat cultivars Gemmiza 12 and Sids 14 at East Canal location (loc. 1) and Shandweel 1 at Al Marashda location (loc.2) exhibited higher grain yield when sown at seed rate of 100 kg fad. $^{-1}$ during the two growing seasons. Insignificant effects between seeding rates by genotypes for number of kernels spike-1 and grain yield were reported by Nizamani *et al.* (2014), suggesting 125 kg ha-1seed rate for achieving higher number of kernels spike^{-1} and grain yields, otherwise, El Hag, (2016) found significant differences between seeding rates and cultivars for number of spikes m^{-2} and grain yield in 1st season and insignificant differences for number of kernels spike^{-1} and 1000 kernels weight during the two growing seasons.

Table 8. Number of spikes m^{-2}, number of kernels spike^{-1}, 1000 kernels weight and grain yield ardab fad. -^{1} as affected by seeding rate × genotypes (SR×G) interaction at the two locations during 2018/2019 growing season.

Seeding rate (SR)	Genotypes (G)	2018-2019 Season							
		No. spikes m^{-2}		No. kernels spike^{-1}		1000 Kernel weight (gm)		Grain yield (ardab/fad.)	
		Loc. 1	Loc. 2	Loc. 1	Loc. 2	Loc. 1	Loc. 2	Loc. 1	Loc. 2
60 Kg fed^{-1}	Gemmeiza 12	190	216	38	42	51.33	33.00	10.05	8.97
	Sids 14	201	235	37	38	51.18	35.65	9.30	9.96
	Shandaweel 1	198	266	33	46	40.14	33.31	7.74	11.72
	Line 1	201	242	36	39	45.47	30.10	8.00	9.38
	Line 2	212	223	35	44	51.07	32.41	7.78	9.77
	Line 3	191	218	34	39	51.69	29.79	8.15	8.36
80 Kg fed^{-1}	Gemmeiza 12	234	229	52	41	55.96	36.09	12.54	11.06
	Sids 14	249	250	57	40	56.94	38.51	13.91	11.89
	Shandaweel 1	229	283	48	49	51.09	36.24	11.66	13.80
	Line 1	240	255	52	41	50.62	32.86	11.05	11.27
	Line 2	245	236	52	45	54.19	35.21	12.53	10.41
	Line 3	236	230	53	41	54.87	32.47	12.55	9.51
100 K g fed^{-1}	Gemmeiza 12	262	237	47	45	56.58	39.42	15.03	12.75
	Sids 14	284	259	52	43	57.28	42.28	14.53	13.84
	Shandaweel 1	267	293	44	52	48.83	39.80	13.86	15.99
	Line 1	294	266	47	44	50.46	35.97	12.11	12.57
	Line 2	302	246	45	48	55.07	38.62	13.60	13.12
	Line 3	278	239	46	44	54.67	35.56	13.33	11.38
L.S.D. 0.05		ns	ns	2.85	ns	2.19	ns	ns	ns

Table 9. Number of spikes m^{-2}, number of kernels $spike^{-1}$, 1000 kernels weight and grain yield ardab fad. $^{-1}$ as affected by seeding rate × genotypes (SR×G) interaction at the two locations during 2019/2020 growing season.

Seeding rate (SR)	Genotypes (G)	2019/2020 Season							
		No. spikes m^{-2}		No. kernels $spike^{-1}$		1000 Kernel weight (gm)		Grain yield (ardab/fad.)	
		Loc. 1	Loc. 2	Loc. 1	Loc. 2	Loc. 1	Loc. 2	Loc. 1	Loc. 2
60 Kg fed^{-1}	Gemmeiza 12	168	237	43	48	56.34	38.75	11.89	10.14
	Sids 14	175	259	46	44	56.61	41.59	12.2	11.34
	Shandaweel 1	161	288	39	54	45.06	39.41	10.94	12.8
	Line 1	170	266	40	45	49.94	35.61	11.02	10.31
	Line 2	175	245	41	51	54.87	38.23	11.55	10.89
	Line 3	167	238	43	46	57.33	35.32	11.28	9.12
80 Kg fed^{-1}	Gemmeiza 12	192	253	56	50	58.42	42.7	13.84	12.03
	Sids 14	201	264	59	48	60.77	45.79	14.64	13.17
	Shandaweel 1	171	310	56	57	52.26	42.88	12.59	14.63
	Line 1	182	279	54	47	51.8	38.76	12.4	11.81
	Line 2	199	259	47	51	58.11	41.66	12.28	12.35
	Line 3	185	253	48	49	59.52	38.41	12.44	10.47
100 K g fed^{-1}	Gemmeiza 12	204	261	50	53	60.23	46.74	15.52	13.34
	Sids 14	211	285	54	52	62.44	49.96	15.42	14.3
	Shandaweel 1	176	322	48	57	52.51	47.1	14.78	16.24
	Line 1	187	292	51	50	54.99	42.58	14.04	13.17
	Line 2	203	270	49	53	60.4	45.49	14.53	14.15
	Line 3	189	263	50	53	60.97	42.19	14.76	12.62
L.S.D. 0.05		ns	ns	2.97	ns	1.46	ns	ns	ns

The interaction effects of N fertilizer levels by genotypes (N × G) (**Tables 10 and 11)** was significant only for number of kernels $spike^{-1}$ and 1000 kernels weight at East Canal location (loc.1) in the 2018-2019 growing season, but it was insignificant for all studied traits at Al Marashda location (loc. 2) in the two growing seasons. Increasing nitrogen fertilizer levels up to 125 kg N fad. ^{1} increased grain yield and its components of the six bread wheat genotypes at Al Marashda location (loc. 2) in the two growing seasons, but it was insignificantly. Regarding East Canal location (loc.1) in the 2018-2019 growing season, the two-bread wheat promising lines 2 and 3 showed higher response to increase N fertilizer from 75 kg N fad. ^{1} to 100 kg N fad. up to 125 kg N fad. ^{1} for number of kernels $spike^{-1}$, whereas, the bread wheat promising line 1 exhibited highly significant response to increasing N fertilizer from 100 kg N fad. ^{1} to 125 kg N fad. ^{1} for 1000 kernels weight.

Table 10. Number of spikes m^{-2}, number of kernels spike^{-1}, 1000 kernels weight and grain yield ardab fad. -^{1} as affected by N fertilizer levels× genotypes (N×G) interaction at the two locations during 2018/2019 growing season

N levels (N)	Genotypes (G)	2018-2019 Season							
		No. spikes m^{-2}		No. kernels spike^{-1}		1000 Kernel weight (gm)		Grain yield (ardab/fad.)	
		Loc. 1	Loc. 2	Loc. 1	Loc. 2	Loc. 1	Loc. 2	Loc. 1	Loc. 2
75 Kg fed^{-1}	Gemmeiza 12	219	209	42	40	53.21	33.71	10.83	8.74
	Sids 14	234	223	45	38	54.91	36.08	10.67	9.8
	Shandaweel 1	221	254	39	47	46.31	33.95	9.7	11.77
	Line 1	227	228	42	39	47.72	30.71	9.02	8.74
	Line 2	229	212	38	42	51.12	32.99	9.93	8.38
	Line 3	226	209	42	39	54.61	30.57	10.06	7.79
100 Kg fed^{-1}	Gemmeiza 12	226	231	46	43	54.49	35.98	13.46	10.83
	Sids 14	239	248	50	40	54.74	38.51	13.07	11.8
	Shandaweel 1	236	282	42	49	47.1	36.02	11.71	13.83
	Line 1	252	256	46	41	47.13	32.79	10.2	11.19
	Line 2	258	235	46	47	53.87	35.46	11.6	12.08
	Line 3	234	235	44	41	53.11	32.52	12.05	10.06
125 Kg fed^{-1}	Gemmeiza 12	241	242	48	45	56.17	38.82	13.33	13.21
	Sids 14	261	272	50	42	55.74	41.84	13.99	14.1
	Shandaweel 1	237	307	44	51	46.66	39.38	11.86	15.9
	Line 1	256	279	47	44	51.69	35.42	11.94	13.3
	Line 2	270	258	49	48	55.33	37.79	12.39	12.84
	Line 3	244	243	48	44	53.5	34.72	11.92	11.39
L.S.D. 0.05		ns	ns	2.85	ns	2.19	Ns	ns	ns

Table 11. Number of spikes m^{-2}, number of kernels spike^{-1}, 1000 kernels weight and grain yield ardab fad. -^{1} as affected by N fertilizer levels× genotypes (N×G) interaction at the two locations during 2019/2020 growing season.

N levels (N)	Genotypes (G)	2019-2020 Season							
		No. spikes m^{-2}		No. kernels spike^{-1}		1000 Kernel weight (gm)		Grain yield (ardab/fad.)	
		Loc. 1	Loc. 2	Loc. 1	Loc. 2	Loc. 1	Loc. 2	Loc. 1	Loc. 2
75 Kg fed^{-1}	Gemmeiza 12	188	230	48	47	56.98	39.67	13.03	10.18
	Sids 14	195	246	52	45	58.71	42.37	13.14	11.06
	Shandaweel 1	170	278	47	54	48.92	40.17	11.95	12.57
	Line 1	176	250	48	44	50.98	36.35	11.78	9.97
	Line 2	194	233	43	48	56.28	38.92	11.98	10.55
	Line 3	181	230	46	46	58.46	36.27	11.78	9.11
100 Kg fed^{-1}	Gemmeiza 12	190	254	50	51	58.42	42.58	14.09	11.8
	Sids 14	197	273	52	48	60.3	45.81	13.88	12.96
	Shandaweel 1	170	307	47	56	50.61	42.63	13.16	14.34
	Line 1	181	280	49	49	52.07	38.69	12.44	11.88
	Line 2	193	258	46	54	57.98	41.96	12.83	12.75
	Line 3	177	259	47	49	59.37	38.57	13.12	11.22
125 Kg fed^{-1}	Gemmeiza 12	187	266	51	54	59.6	45.95	14.13	13.53
	Sids 14	194	290	54	50	60.82	49.15	15.24	14.79
	Shandaweel 1	168	334	49	59	50.29	46.59	13.21	16.76
	Line 1	182	307	49	49	53.69	41.92	13.25	13.44
	Line 2	189	284	48	53	59.12	44.5	13.55	14.1
	Line 3	183	266	48	52	60	41.09	13.58	11.88
L.S.D. 0.05		ns	ns	ns	Ns	ns	Ns	ns	ns

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