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GRAIN QUALITY AND PROTEIN YIELD OF THREE BREAD WHEAT CULTIVARS AS AFFECTED BY SOME HUMIC ACID AND COMPOST FERTILIZER TREATMENTS UNDER NEWLY SANDY SOIL CONDITIONS

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ABSTRACT: Two field experiments were carried out during 2015/2016 and 2016/2017 winter seasons at El-Qantara East. Station, Desert Res. Center, North Sinai, Egypt to investigate the effect of some humic acid and organic compost fertilizer treatments on total carbohydrates, protein contents and protein yield/fad., of three bread wheat cultivars, grown under newly reclaimed sandy soil. Each experiment included 48 treatments which are the combinations between three wheat cultivars (Misr-1; Sakha-94 and Gemmeiza-11), four levels of humic acid (without humic acid; 1, 2 and 3 kg/fad.) and four levels of compost fertilizer (without compost, 5, 10 and 20 ton/fad.). The results revealed significant differences among wheat cultivars for protein percentage, protein yield and total carbohydrate contents in wheat grains. The results also showed that Misr-1 cultivar significantly surpassed the other two studied cultivars in carbohydrate percentage in both seasons. However, wheat cultivar Sakha-94 exceeded markedly the other two cultivars in protein percentage and protein yield. Application of either humic acid or compost fertilizer significantly enhanced protein percentage, protein yield and total carbohydrate content in wheat grains. The highest protein yield (238 in the 1st season and 270 kg/fad., in the 2nd one) was produced from Sakha-94 wheat cultivar with application of 20 ton/fad., compost in both seasons under Qantara East Area, North Sinai of Egypt.

Key words: Bread wheat, cultivars, humic acid, compost, protein yield, fertilizer.

INTRODUCTION

Bread wheat (*Triticum aestivum* L.) is the most important and staple food crop for the vast majority of the human population. Its grains are used as food for human nutrition and as industrial materials. Recently, it is grown on roughly 225 million hectares worldwide with a total production of approximately 750 million tons **(FAO STAT, 2016).** It occupies a vital position in agricultural policies of Egypt. The cultivated area of wheat in Egypt is about 1.34 million hectares with a total production of around 8.8 million tons (**Anonymous, 2016**). Egypt imports annually about 45% of its wheat requirements. This reflects the size of the problem and the efforts needed to maximize wheat production in Egypt, through adopting the high yielding cultivars and applying the most preferable agronomic practices, particularly under newly sandy soil cultivation.

The newly reclaimed soil in North Sinai is characterized by increasing salinity either in soil or in irrigated water and poor in mineral nutrients. It is well known that, salinity and low fertility of the soil negatively affect the chemical composition of wheat grains.

Wheat grains are mainly composed of carbohydrate and protein. The differences in the levels of carbohydrate and protein significantly affected the quality of the products made from wheat grains.

El-Shabrawi *et al.* (2015) assessed the performance of grain protein content of two wheat cultivars (Gemmeiza-9 and Sakha-93).

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They reported that protein (%) varied from 10.01% in Gemmeiza-9 to 11.41% in Sakha-93 cultivars and protein yield (kg/ha) varied from 341.41 kg/ha in Gemmeiza-9 to 299.00 kg/ha in Sakha-93 cultivar.

Kandil *et al.* (2016) reported that protein contents in wheat grains varied from 11.31% in Sakha-93, 10.37% in Gemmeiza-9 and 10.89% in Giza-168 (averages of both seasons). Orderly while, the same mentioned cultivars had significant values of carbohydrate (%) which varied from 77.33% in Shaka-93, 78.48% in Gemmeiza-9 and 77.60% in Giza-168 (means of both seasons). In addition, they found that, foliar spraying with 3 kg/ha humic acid increased protein (%) by 7% and 8% and total carbohydrates by 3% and 2% (averages in the three examined cultivars) as compared to the untreated plants in the first and second season, respectively.

Kebkab *et al.* (2017) investigated the effects of three levels of compost fertilizer (0, 10 and 20 ton/ha) on protein content in wheat grains. They found that the highest level of compost (20 ton/fad.) significantly increased wheat grain protein content (%) from 9.51% to 10.28%.

The object of the present study is to look at the differences in grain carbohydrate and protein contents among three bread wheat cultivars as affected by different levels of humic acid and compost fertilizer under newly reclaimed sandy soil conditions.

MATERIALS AND METHODS

Two field experiments were carried out during the 2015/2016 and 2016/2017 winter seasons at El-Qantara East Station, Desert Research Center, North Sinai, Egypt.

The experiments were designed in a split-split plot system with four replicates. Each experiment included 48 treatments which are the combinations between three wheat cultivars, four levels of humic acid and four levels of compost fertilizer. The main plots included the three wheat cultivars as follows: Misr-1 (V_1), Sakha-94 (V_2) and Gemmeiza-11 (V_3).

The chosen cultivars were obtained from Wheat Research Section, Field Crop Research Institute, Agric. Res. Center, Giza, Egypt. The pedigree and origin of these cultivars are presented in Table 1.

The sub-plots were devoted to the four levels of humic acid as follows:

1. Without humic acid application (HA_0).
2. Application of 1 kg humic acid/fad. (HA_1).
3. Application of 2 kg humic acid/fad. (HA_2).
4. Application of 3 kg humic acid/fad. (HA_3).

Humic acid was mixed with one kg sand for each sub-sub plot and added to the soil before cultivation.

The four levels of compost fertilizer were randomly allocated in the sub-sub-plots as follows:

1. Without compost application (C_0).
2. Application of 5 tons compost/fad. (C_1).
3. Application of 10 tons compost/fad. (C_2).
4. Application of 20 tons compost/fad. (C_3).

The chemical analysis of compost is shown in Table 3. The compost was added to the soil before cultivation.

The sub- sub-plot area was 3.5 m length × 3 m width occupying an area of 10.5 m^2 and represented 1/400 of faddan. Grains of wheat cultivars at the rate of 60 kg/fad., (according to 1000-grain weight of each studied cultivar) were sown on 15 November in both seasons using hand drilling method in rows 3.5 m length and 20 cm apart.

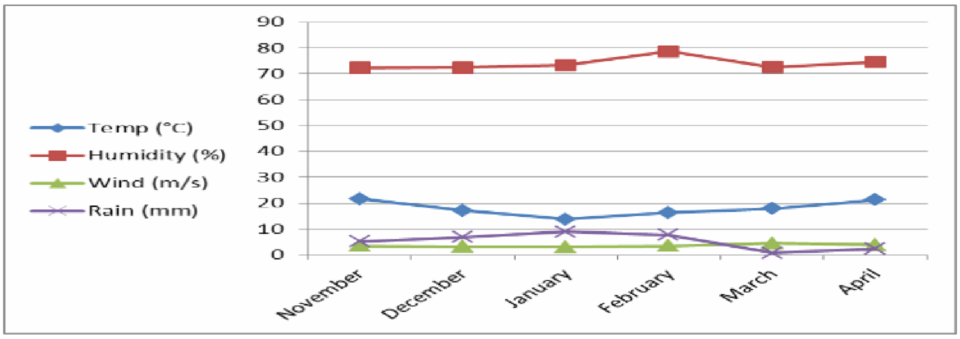
Meteorological data were obtained from Meteorological Station situated in El-Qantara East Station, Desert Research Center in both seasons as presented in Fig. 1.

Soil samples were taken before sowing wheat in both seasons to a depth of 0-15 cm and 15-30 cm and were subjected to physical and chemical analyses. The mechanical and chemical properties of the experimental soils were estimated as listed in Table 2. The irrigation water in both seasons was analyzed for pH, EC, cations and anions as shown in Table 2.

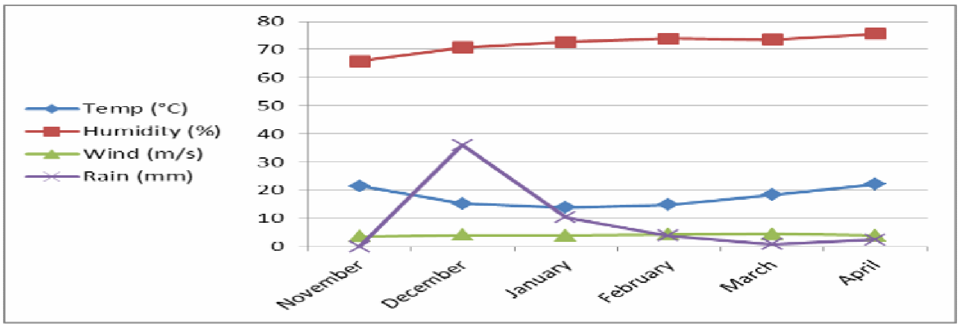
The experimental field was well prepared through two plowings, compacted, and then divided into experimental units with dimensions as previously mentioned. Calcium superphosphate

Table 1. Pedigree of the studied wheat cultivars

Genotype	Pedigree	Origin
Misr-1	OASIS/KAUZ//4*BCN/3/2*PASTOP. CMssooY 01881T-050M-030Y-030M-030WGY-33M-OY-OS	Egypt
Sakha-94	OPATA/RAYON//KAUZ.CMBW 90Y3180-OTOPM-3Y-010M-010Y-10M-015Y-0Y-0AP-0S.	Egypt
Gemmeiza-11	BOW "S"/KZ "S" //7C/aeri 82/3/Giza 168/Sakha61. GM78922-GM-1GM-2GM-1GM-0GM	Egypt



2015-2016



2016-2017

Fig. 1. Meteorological parameters of El-Qantara East. Station, Desert Res. in 2015/2016 and 2016/ 2017 growing seasons

Table 2. Mechanical and chemical analyses of the experimental soil as well as some chemical properties of the irrigation water during 2015/16 and 2016/17 seasons

Soil analyses			2015/16 season		2016/17 season	
			0-15	15-30	0-15	15-30
			Mechanical analysis			
Sand (%)			87.40	87.40	86.02	86.02
Silt (%)			9.20	9.20	9.65	9.65
Clay (%)			3.40	3.40	4.23	4.23
Soil texture class			Sandy	Sandy	Sandy	Sandy
			Chemical analysis			
$CaCo_3$			0.37	0.20	0.33	0.23
pH			7.95	8.34	7.86	8.53
EC ($dS.m^{-1}$)			0.72	0.55	0.70	0.54
Organic matter (%)			0.54	0.54	0.68	0.65
Na^+			3.85	2.72	3.74	2.71
K^+			0.36	0.29	0.35	0.28
Ca^{++}			1.66	1.43	1.58	1.42
Mg^{++}			1.33	1.07	1.31	1.05
HCO_3^-			1.99	1.72	1.97	1.71
Cl^-			3.32	2.86	3.30	2.85
SO^{--}_4			1.89	0.93	1.87	0.91
SAR			3.15	2.43	3.14	2.42
ESP			3.27	2.26	3.26	2.24
			Irrigated water			
EC (µS/cm)			2960		2974	
pH			8.3		8.6	
Soluble ions (meq l^{-1})	**Cation**	Ca^{++}	6.71		6.86	
		Mg^{++}	8.39		8.43	
		Na^+	14.35		14.47	
		K^+	0.28		0.29	
	Anion	CO_3^{--}	0.3		0.4	
		HCO_3^{--}	2.9		2.9	
		Cl^-	22.2		22.4	
		SO_4^{--}	3.1		3.6	

Soil Water Analysis, Lab., Desert Research Center.

Table 3. Chemical analysis of compost

Character	Compost	Character	Compost
Wight (m^3 kg)	665	Humidity (%)	23
Ammonium nitrogen (ppm)	67	pH	6.87
Nitrate nitrogen (ppm)	17	E C ($dS.m^{-1}$)	4.57
Organic matter (%)	30.50	Total nitrogen (%)	1
Organic carbon (%)	14.79	Ash (%)	74.5
Total phosphorus (%)	0.73	C/N ratio	1:14
Total potassium (%)	1.03	Grass	0
Nematode			
Nurse of the plant 200 g	0	Free non-nurse 200 g	0

(15.5% P_2O_5) was applied during soil bed preparation at the rate of 31 kg P_2O_5/fad. Potassium sulphate (48-52% k_2O) was broadcasted at the rate of 48 kg k_2O/fad., before sowing.

Nitrogen fertilizer in the form of ammonium sulphate (20.6% N) was added as broadcasting at the rate of 20.6 kg N/fad., before sowing. In addition, nitrogen fertilizer in the form of ammonium nitrate (33.5% N) was applied at three equal doses prior irrigation with the rate of 33.5 kg N/fad., after 25, 50 and 75 days from sowing. Irrigation was applied using sprinkler system. The common agricultural practices for growing wheat according to the recommendations of Ministry of Agriculture were followed, except the factors under study.

Recorded Data

Samples of grains representing each sub-sub plot were milled and subjected to the chemical analysis using the new Kjeldahle method as outlined by the **AOAC (1980)** to determine N (%).

Protein content (%) was determined by multiplying nitrogen percentage × 6.25.

Protein yield/fad., was estimated by multiplying protein content (%) × grain yield/ fad.

Total carbohydrate content was determined in wheat grains by phenol-sulfuric acid according to **Dubois *et al.* (1956)** method.

Statistical Analysis

The obtained data were subjected to statistical analysis using the technique of analysis of variance (ANOVA) for the split-split design as described by **Gomez and Gomez (1984).** The **MSTAT-C (1991)** statistical package was used with MGRAPH version 2.10. The differences between treatment means were estimated using the least significant difference (LSD) method at 5% level of probability as described by **Snedecor and Cochran (1980)**.

RESULTS AND DISCUSSION

It is evident from the results that protein (%), protein yield and total carbohydrate content in the second season were relatively higher than that of the first one. These results could be explained on the basis that the experimental soil of the second season exceeded that of the first one in organic matter (Table 2). In addion the amount of rainfed during December was more in the second season than in the first one (Fig. 1).

The combined analysis of the two seasons (Table 4) revealed significant differences among wheat cultivars, for protein percentage. Wheat cultivar Sakha-94 had the highest value (11.1%) followed by Gemmeiza-11 (10.7%) and then Misr-1 (10.6%). Varietal differences for protein percentage were also reported by **Hendawey (2009)** who recorded different values of protein

Table 4. Effect of humic acid and compost treatments on carbohydrate and protein contents and protein yield/fad., of the three wheat cultivars in each season and over seasons, orderly

Main effects and interactions	Protein (%)			Protein yield (kg/fad.)			Carbohydrate (%)		
	1st	2nd	Combined	1st	2nd	Combined	1st	2nd	Combined
Cultivars (V)									
Misr-1	10.4b	10.8b	10.6b	160.0b	183.8b	171.7b	70.4b	72.2a	71.3a
Sakha-94	11.0a	11.2a	11.1a	178.0a	198.3a	187.9a	68.6ab	70.3ab	69.5ab
Gemmeiza11	10.5b	10.8b	10.7b	147.0c	160.4c	153.8c	67.4b	69.1b	68.3b
F-test	*	*	*	**	**	**	*	*	*
Humic acid (H)									
Without	10.2d	10.5d	10.3d	142.0d	158.9d	150.5d	66.7d	68.4d	67.5d
1 kg/fad	10.4c	10.7c	10.5c	154.0c	171.8c	162.9c	68.3c	70.0c	69.2c
2 kg/fad.	10.7b	11.0b	10.9b	168.0b	187.0b	177.3b	69.5b	71.3b	70.4b
3 kg/fad.	11.1a	11.4a	11.3a	182.0a	205.6a	193.8a	70.7a	72.5a	71.6a
F-test	**	**	**	**	**	**	**	**	**
Compost (C)									
Without	9.1d	9.4d	9.2d	97.8d	108.4d	103.2d	61.6d	63.1d	62.3d
5 ton/fad.	10.1c	10.3c	10.2c	138.0c	153.2c	145.7c	66.0c	67.6c	66.8c
10 ton/fad.	10.9b	11.1b	11.0b	172.0b	191.4b	181.6b	71.6b	73.4b	72.5b
20 ton/fad.	12.4a	12.8a	12.6a	238.0a	270.0a	254.0a	76.2a	78.1a	77.2a
F-test	**	**	**	**	**	**	**	**	**
Interaction									
V×H	**	**	**	**	**	**	**	**	**
V×C	**	**	**	**	**	**	**	**	**
H×C	**	**	**	**	**	**	**	**	**
V×H×C	NS	NS	NS	NS	NS	NS	NS	NS	NS

percentage of three wheat cultivars. Protein percentage in wheat grains was 12.9% in Sakha-93, 11.9% in Gemmeiza-7 and 11.8% in Gemmeiza-10. This finding confirmed the results obtained in the current study.

Application of humic acid treatments significantly increased protein percentage in wheat grains. According to the results of combined analysis of the two seasons (Table 4), the increases of protein percentage in wheat grains were 2.0%, 5.3% and 9.4% due to addition of 1, 2 and 3 kg humic acid/fad. These results are supported by the findings of **El-Shabrawi *et al* (2015)** who reported an increase of protein content about 11% due to spraying 17 mg/l humic acid.

Addition of 5, 10 and 20 ton compost/fad., significantly ameliorated protein percentage of wheat grains (Table 4) by 10.2%, 18.9% and 36.5% as compared to the untreated plants, respectively. These results are in agreement with those reported by **Demelash *et al.* (2014),**

Mansour *et al.* (2015) and **Kebkab *et al.* (2017)** who recorded an increase of 8.1% for protein (%) by application of 20 ton compost/ha.

The combined analysis of the two seasons (Table 4) revealed significant differences among wheat cultivars, for protein yield (kg/fad). Wheat cultivar Sakha-94 had the highest value (187.9%) followed by Misr-1 (171.7%) and then Gemmeiza-11 (153.8%). Varietal differences for protein yield (kg/fad.) were also reported by **Wali *et al.* (2015)** who recorded different values of protein yield (kg/fad.) of two wheat (Misr-1 and Gemmiza-11) cultivars. Protein yield (kg/fad.) in wheat grains was 240.3 kg/fad., in Misr-1 and 172.6 kg/fad., in Gemmeiza-11. This finding confirmed the results obtained in the current study.

Application of humic acid treatments significantly increased protein yield (kg/fad.) in wheat grains. According to the results of combined analysis of the two seasons (Table 4), the increases of protein yield (kg/fad.) in wheat grains were 8.2%, 17.8% and 28.8% due to addition of 1, 2 and 3 kg humic acid/fad. These results are supported by the findings of **Bakry *et al.* (2013)** who reported an increase of about 63.5% protein yield due to spraying 17 mg/l humic acid.

Application of 5, 10 and 20 ton compost/fad., significantly ameliorated protein yield (kg/fad.) of wheat grain cultivars (Table 4) by 41.18%, 75.97% and 146.12% as compared to the untreated plants, respectively.

The combined analysis of the two seasons (Table 4) also revealed significant differences among wheat cultivars, for carbohydrates percentage. Wheat cultivar Misr-1 had the highest value (71.3%) followed by Sakha-94 (69.5%) and then Gemmeiza-11 (68.3). respectively. Varietal differences for carbohydrates percentage was also reported by **Zaki *et al* (2015)** who recorded different values of carbohydrate percentage of two wheat cultivars. Carbohydrate percentage in wheat grains was 80.2% in Baniswef-4 and 83.5% in Misr-2. This finding confirmed the results obtained in the current study.

Application of humic acid significantly increased the carbohydrate percentage in wheat grains. According to the data of combined analysis of the two seasons (Table 4), the increases of carbohydrate percentage in wheat grains were 2.4%, 4.2% and 6.0% due to addition of 1, 2 and 3 kg humic acid/fad. These results are emphasized by the findings of **Kandil *et al.* (2016)** who documented an increase of about 2.8% due to spraying 3 kg/ha humic acid.

Addition 5, 10 and 20 ton compost/fad., significantly ameliorated carbohydrate percentage of wheat grains (Table 4) by 7.1%, 16.3% and 23.8% as compared to the untreated plants, respectively. These results are similar to the findings of **Araya (2017)**.

The interaction effect between wheat cultivars and humic acid was highly significant for protein percentage (Table 5). The highest protein percentage (11.6%) was attained in wheat cultivar Sakha-94 and application of 3 kg humic acid/fad. Whereas, the lowest value (10.1%) was occurred in Misr-1 without application of humic acid. In this connection, **Bakry *et al.* (2013)** reported significant interaction effect between wheat cultivars and humic acid application for protein percentage in wheat grains.

The interaction effect between wheat cultivars and compost fertilizer was highly significant for protein percentage (Table 5). The highest protein percentage (13.0%) was attained in wheat cultivar Sakha-94 and application of 20 ton compost/fad. Whereas, the lowest value (9.1%) was occurred in Misr-1 cultivar without application of compost fertilizer.

The interaction effect between humic acid and compost treatments was highly significant for protein percentage (Table 5). The highest protein percentage (13.3%) was obtained in wheat plants treated with 3 kg humic acid/fad., and application of 20 ton compost/fad. Whereas, the lowest value (9.0%) was obtained in wheat plants without application of humic acid and compost fertilizer levels.

The combined analysis (Table 6) showed that the interaction effect between wheat cultivars and humic acid was highly significant for protein yield (kg/fad.). The highest protein yield (214 kg/fad.) was attained in wheat cultivar Sakha-94 and application of 3 kg humic acid/fad. Whereas, the lowest value (136 kg/fad.) was

Table 5. Effect of the interaction between wheat cultivars and compost fertilizer levels, wheat cultivars and humic acid, humic acid and compost levels on protein percentage of wheat under newly reclaimed sandy soil conditions during the two growing seasons 2015/2016 and 2016/2017 and their pooled data

Main effects and interactions	First season				Second season				Combined			
	HA_0	HA_1	HA_2	HA_3	HA_0	HA_1	HA_2	HA_3	HA_0	HA_1	HA_2	HA_3
	C_0	C_1	C_2	C_3	C_0	C_1	C_2	C_3	C_0	C_1	C_2	C_3
Interaction effect between wheat cultivars, and humic acid												
	D	C	B	A	D	C	B	A	D	C	B	A
Misr-1	9.9c	10.1c	10.5c	10.9c	10.3b	10.5b	10.9b	11.3b	10.12c	10.3c	10.7c	11.1c
	D	C	B	A	D	C	B	A	D	C	B	A
Sakha-94	10.5a	10.7a	11.1a	11.5a	10.7a	10.9a	11.3a	11.7a	10.60a	10.8a	11.2a	11.6a
	D	C	B	A	D	C	B	A	D	C	B	A
Gemmeiza11	10.1b	10.3b	10.7b	11.1b	10.3b	10.5b	10.9b	11.3b	10.20b	10.4b	10.8b	11.2b
Interaction effect between wheat cultivars, and compost												
	D	C	B	A	D	C	B	A	D	C	B	A
Misr-1	8.9c	9.8c	10.6c	12.1c	9.2b	10.2b	11.0b	12.6b	9.1c	10.0c	10.8c	12.4c
	D	C	B	A	D	C	B	A	D	C	B	A
Sakha-94	9.4a	10.4a	11.2a	12.9a	9.6a	10.6a	11.4a	13.1a	9.5a	10.5a	11.3a	13.0a
	D	C	B	A	D	C	B	A	D	C	B	A
Gemmeiza 11	9.1b	10.0b	10.8b	12.4b	9.2b	10.2b	11.0b	12.6b	9.1b	10.1b	10.9b	12.5b
Interaction effect between humic acid and compost												
	D	C	B	A	D	C	B	A	D	C	B	A
Without	8.8d	9.9d	10.4d	11.7d	9.1d	10.1d	10.6d	12.0d	9.0d	10.0d	10.5d	11.9d
1 kg/fad.	D	C	B	A	D	C	B	A	D	C	B	A
	8.9c	10.0c	10.6c	12.1c	9.2c	10.2c	10.8c	12.5c	9.0c	10.1c	10.7c	12.3c
2 kg/fad.	D	C	B	A	D	C	B	A	D	C	B	A
	9.0b	10.1b	11.0b	12.9b	9.3b	10.3b	11.3b	13.2b	9.1b	10.2b	11.2b	13.1b
3 kg/fad.	D	C	B	A	D	C	B	A	D	C	B	A
	9.7a	10.3a	11.5a	13.1a	10.0a	10.5a	11.8a	13.5a	9.8a	10.4a	11.7a	13.3a

**:Significant at 0.01 level of probability, and NS: Not significant. HA_0): without humic acid; HA_1): 1kg/fad., HA_2): 2 kg/fad., HA_3): 3kg/fad. C_0): without Compost; C_1): 5 ton /fad., C_2): 10 ton/fad., C_3): 20 ton/fad.

Table 6. Effect of the interaction between wheat cultivars and compost, wheat cultivars and humic acid, humic acid and compost on protein yield (kg/fad.) of wheat under newly reclaimed sandy soil conditions during the two growing seasons of 2015/2016 and 2016/2017 and over seasons, respectively

Main effects and interactions	First season				Second season				Combined			
	HA_0	HA_1	HA_2	HA_3	HA_0	HA_1	HA_2	HA_3	HA_0	HA_1	HA_2	HA_3
	C_0	C_1	C_2	C_3	C_0	C_1	C_2	C_3	C_0	C_1	C_2	C_3
Interaction effect between wheat cultivars, and humic acid												
	D	C	B	A	D	C	B	A	D	C	B	A
Misr-1	142b	151b	166b	179b	162b	172b	191b	209b	152b	162b	179b	194b
	D	C	B	A	D	C	B	A	D	C	B	A
Sakha-94	155a	170a	185a	201a	172a	189a	205a	227a	164a	180a	195a	214a
	D	C	B	A	D	C	B	A	D	C	B	A
Gemmeiza11	129c	140c	152c	166c	142c	154c	165c	180c	136c	147c	159c	173c
Interaction effect between wheat cultivars, and compost												
	D	C	B	A	D	C	B	A	D	C	B	A
Misr-1	99b	137b	170b	233b	112b	155b	194b	275b	106b	146b	182b	254b
	D	C	B	A	D	C	B	A	D	C	B	A
Sakha-94	107a	153a	192a	258a	118a	169a	211a	296a	113a	161a	202a	277a
	D	C	B	A	D	C	B	A	D	C	B	A
Gemmeiza11	87c	124c	154c	223c	95.9c	136c	169c	240c	92c	130c	162c	232c
Interaction effect between humic acid and compost												
	D	C	B	A	D	C	B	A	D	C	B	A
Without	79d	127d	157d	205d	88d	141d	175d	232d	84d	134d	166d	219d
1 kg/fad.	D	C	B	A	D	C	B	A	D	C	B	A
	93c	134c	165c	223c	103c	149c	184c	251c	98c	142c	175c	237c
2 kg/fad.	D	C	B	A	D	C	B	A	D	C	B	A
	101b	142b	176b	251b	112b	157b	196b	282b	107b	150b	186b	267b
3 kg/fad.	D	C	B	A	D	C	B	A	D	C	B	A
	117a	149a	190a	272a	130a	165a	211a	316a	124a	157a	201a	294a

**:Significant at 0.01 level of probability, and NS: Not significant. HA_0): without humic acid; HA_1): 1 kg/fad., HA_2): 2 kg/fad., HA_3): 3 kg/fad., C_0): without compost; C_1): 5 ton/fad., C_2): 10 ton/fad., C_3): 20 ton/fad.

occurred in Gemmeiza-11 without application of humic acid. In this connection, **El-Shabrawi *et al.* (2015)** reported significant interaction effect between wheat cultivars and humic acid for protein yield (kg/fad.).

The interaction effect between wheat cultivars and compost was highly significant for protein yield (Table 6). The highest protein yield (kg/ fad.) (277 kg/fad.) was attained in wheat cultivar Sakha-94 and application of 20 ton compost/fad. Whereas, the lowest value (92 kg/ fad.) was occurred in Gemmeiza-11 without application of compost fertilizer. Also significant interaction effect between wheat cultivars and the levels of compost for protein yield (kg/fad.) was recorded.

The interaction effect of humic acid treatments and compost was highly significant for protein yield (kg/fad.) (Table 6). The highest protein yield (294 kg/fad.) was obtained in wheat plants treated with 3 kg humic acid/fad. and application of 20 ton compost/fad. Whereas, the lowest value (84 kg/fad.) was documented in wheat plants without application of humic acid and compost treatments.

The combined analysis (Table 7) showed that the interaction effect between wheat cultivars and humic acid was highly significant for carbohydrate percentage. The highest carbohydrate percentage (73.3%) was appeared in wheat cultivar Misr-1 and application of 3 kg humic acid/fad. Whereas, the lowest value (66.2%) was noticed in Gemmeiza-11 cultivar without application of humic acid. In this regard, **Kandil *et al.* (2016)** reported significant interaction effect between wheat cultivars and humic acid for carbohydrate percentage.

The interaction effect between wheat cultivars and compost was highly significant for carbohydrate percentage (Table 7). The highest carbohydrate percentage (79.0%) was appeared in wheat cultivar Misr-1 and application of 20 ton compost/fad. At the same-time, the lowest value (61.1%) was occurred in Gemmeiza-11 without application of compost fertilizer.

The interaction effect between humic acid and compost treatments was highly significant for carbohydrate percentage (Table 7). The highest carbohydrates percentage (80.1%) was obtained in wheat plants treated with 3 kg humic acid/fad., and application of 20 ton compost/fad. On other score, the lowest value (59.8%) was given in wheat plants without application of humic acid and compost treatments.

Table 7. Effect of the interaction between wheat cultivars and compost, wheat cultivars and humic acid, humic acid and compost on carbohydrate percentage of wheat grains under newly reclaimed sandy soil conditions during the two growing seasons of 2015/2016 and 2016/2017 and across seasons, successively

Main effects and Interactions	First season				Second season				Combined			
	HA_0	HA_1	HA_2	HA_3	HA_0	HA_1	HA_2	HA_3	HA_0	HA_1	HA_2	HA_3
	C_0	C_1	C_2	C_3	C_0	C_1	C_2	C_3	C_0	C_1	C_2	C_3
Interaction effect between wheat cultivars, and humic acid												
Misr-1	D	C	B	A	D	C	B	A	D	C	B	A
	68.3a	69.9a	71.2a	72.4a	70.0a	71.7a	72.9a	74.2a	69.2a	70.8a	72.1a	73.3a
Sakha-94	D	C	B	A	D	C	B	A	D	C	B	A
	66.5b	68.1b	69.3b	70.5b	68.2b	69.8b	71.0b	72.3b	67.4b	69.0b	70.2b	71.4b
Gemmeiza11	D	C	B	A	D	C	B	A	D	C	B	A
	65.4c	66.9c	68.1c	69.3c	67.0c	68.6c	69.9c	71.0c	66.2c	67.8c	69.0c	70.1c
Interaction effect between wheat cultivars, and compost												
Misr-1	D	C	B	A	D	C	B	A	D	C	B	A
	63.0a	67.5a	73.2a	78.0a	64.6a	69.2a	75.1a	80.0a	63.8a	68.4a	74.2a	79.0a
Sakha-94	D	C	B	A	D	C	B	A	D	C	B	A
	61.4b	65.8b	71.3b	76.0b	62.9b	67.4b	73.1b	77.9b	62.1b	66.6b	72.2b	76.9b
Gemmeiza11	D	C	B	A	D	C	B	A	D	C	B	A
	60.3c	64.6c	70.1c	74.7c	61.8c	66.3c	71.9c	76.5c	61.1c	65.5c	71.0c	75.6c
Interaction effect between humic acid and compost												
Without	D	C	B	A	D	C	B	A	D	C	B	A
	59.1d	64.1d	70.4d	73.2d	60.5d	65.7d	72.2d	75.0d	59.8d	64.9d	71.3d	74.1d
1 kg/fad.	D	C	B	A	D	C	B	A	D	C	B	A
	61.0c	65.3c	71.4c	75.5c	62.5c	66.9c	73.3c	77.5c	61.8c	66.1c	72.4c	76.5c
2 kg/fad.	D	C	B	A	D	C	B	A	D	C	B	A
	62.6b	66.7b	71.8b	77.0b	64.2b	68.3b	73.7b	78.9b	63.4b	67.5b	72.8b	78.0b
3 kg/fad.	D	C	B	A	D	C	B	A	D	C	B	A
	63.6a	67.7a	72.5a	79.1a	65.1a	69.4a	74.3a	81.1a	64.4a	68.6a	73.4a	80.1a

** : Significant at 0.01 level of probability, and NS: Not significant. HA_0): without humic acid; HA_1): 1 kg/fad., HA_2): 2 kg/fad., HA_3): 3 kg/fad., C_0): without compost; C_1): 5 ton/fad., C_2): 10 ton/fad., C_3): 20 ton/fad.

Conclusion

It could be concluded that, cultivation of wheat cultivar Sakha-94 and application of 20 ton compost/fad., and 3 kg humic acid/fad., produced the most protein percentage and protein yield (kg/fad.). However, wheat cultivar Misr-1 and application of 20 ton compost/fad., and 3 kg humic acid/fad., produced the most carbohydrate percentage under the newly reclaimed sandy soil conditions in El-Qantara East, North Sinai Region, Egypt.

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جودة الحبوب ومحصول البروتين لثلاثة أصناف من قمح الخبز تحت تأثير حمض الهيوميك وسماد الكمبوست تحت ظروف الأراضى الرملية حديثة الاستصلاح

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أجريت تجربتين حقليتين خلال موسمى ٢٠١٦/٢٠١٥ و ٢٠١٧/٢٠١٦ على التوالى بمنطقة القنطرة شرق، بهدف دراسة تأثير بعض معاملات حامض الهيوميك (بدون إضافة ١، ٢ و ٣ كجم/فدان) وسماد الكومبوست (بدون إضافة ٥، ١٠ و ٢٠ طن/فدان) على جودة الحبوب ومحصول البروتين/فدان لثلاث أصناف من قمح الخبز(مصر- ١، سخا ٩٤- /جميزة- ١١) تحت ظروف الاراضى الرملية حديثة الاستصلاح في شمال سيناء – جمهورية مصر العربية، ويمكن تلخيص النتائج في الاتي: كانت هناك اختلافات معنوية بين أصناف قمح الخبز في كلا الموسمين. وقد أعطى الصنف سخا- ٩٤ أعلى نسبة بروتين بالحبوب وأعلى انتاجية لمحصول البروتين كجم/فدان في كلا الموسمين، وكذلك سجل الصنف مصر-١ أعلى نسبة كربوهيدرات بحبوب القمح، بينما سجل مصر-١ أقل نسبة بروتين، وجميزة-١١ أقل محصول بروتين ونسبة كربوهيدرات خلال موسمى الدراسة، أظهرت معاملات الاضافة الارضية بحمض الهيوميك (HA_3) والتى احتوت على حمض الهيوميك بمعدل ٣ كجم/فدان تفوقا معنويا حيث أعطت أعلى نسبة بروتين وأعلى انتاجية لمحصول البروتين وأعلى نسبة كربوهيدرات في حبوب قمح الخبز بالمقارنة بالمعاملة ٢ كجم حمض الهيوميك ومعاملة الكنترول وكان ذلك واضحا في كلا موسمى الدراسة وبيانات التحليل التجميعى للموسمين، على التوالى، أظهرت معاملات– كمبوست تأثيرا معنويا على الصفات تحت الدراسة وقد اعطى المستوى ٢٠ طن/فدان اعلى القيم فيما يتعلق بنسبة البروتين، نسبة الكربوهيدرات ومحصول البروتين/فدان بالمقارنة بالمعاملات الاخرى ومعاملة الكنترول وكان ذلك جليا في كلا موسمى الدراسة وفى التحليل المشترك للموسمين على التوالى، نتج عن التفاعل بين بعض أصناف قمح الخبز والإضافة الأرضية بحمض الهيوميك والتسميد بالكمبوست أن أعلى نسبة بروتين وأعلى إنتاجية لمحصول البروتين أمكن الحصول عليها من الصنف سخا٩٤ عند التسميد بالكمبوست بمعدل ٢٠ طن/فدان وأيضًا الإضافة الارضية بحمض الهيوميك بمعدل ٣ كجم/فدان، وأيضًا قد أظهرت النتائج أن أعلى نسبة من الكربوهيدرات في حبوب الصنف مصر-١ قد امكن الحصول عليها عند استخدام نفس معاملتى حمض الهيوميك وسماد الكمبوست السابقتين وكان ذلك اكثر وضوحا في كلا موسمى الدراسة والتحليل التجميعى لهما، على التوالى.

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