

## Interaction Effect of Biological and Organic Fertilizers on Yield and Yield Components of Two Wheat Cultivars

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**T**WO FIELD experiments were carried out during winter seasons 2006/2007 and 2007/2008 in the farm at Faculty of Agriculture (Saba Basha), Alexandria University, Egypt. The local unit area was utilized feddan (fed) 4200 m<sup>2</sup>. The aim of the study was to examine the effect of 3 bio-fertilizers (Cerealine- commercial product contain *Azospirillum* spp., yeast, control) and 4 rates (zero, 10, 20, 30 m<sup>3</sup>/fed) of sheep manure on yield and its components of 2 wheat cultivars (Gemiza-7 and Sakha- 93). The experiment consisted of 24 treatments which were the combinations between three factors : two cultivars, three bio-fertilizers and four organic fertilizer rates in four replicates.

Data indicated that Gemiza-7 surpassed Sakha-93 in spike length, number of grains/spike, grain, straw, biological yields/fed and harvest index %. while Sakha-93 surpassed Gemiza-7 in number of spikes/m<sup>2</sup>, spike weight and weight of 1000-grains.

The bio-fertilizer (yeast) had the superiority in number of spikes/m<sup>2</sup>. The organic fertilizer (30 m<sup>3</sup>/fed) in the form of sheep manure gave the best results for all studied characters. The interaction between Sakha-93 and yeast gave the best results for all other studied characters. The interaction between Sakha-93 and 30 m<sup>3</sup>/fed sheep manure gave the best yield and yield attributes. The interaction between yeast and 30 m<sup>3</sup>/fed sheep manure surpassed the other interactions for all studied characters. The interactions of the three factors indicated that interaction of Sakha-93 x yeast x 30. m<sup>3</sup>/fed sheep manure gave the best results for all studied characters.

**Keywords :** Sheep manure , Yeast , *Azospirillum*'spp.

Wheat (*Triticum aestivum* L.) is the most important cereal crop in the world regarding cultivated area. Increasing grain yield of wheat is an important national goal to face the continuous increasing food needs of Egyptian population. Wheat production in Egypt increased from 2.08 in 1983 to 7.37 million ton in 2007. This increase was done by increasing wheat area from 1.83 to 2.71 million fed / year and grain yield from 1.50 to 2.71 ton/fed for the same period (AERMAE 2007).

The suitable cultivar for soil type and environmental condition of cultivated district is one of the limited factors in wheat production. Many researchers found that wheat cultivars are varied in growth yield and yield components. Gad El-Rab *et al.* (1995) pointed out that wheat cultivars significantly differed due to the soil conditions (Yousef & Hanna, 1998), Sultan *et al.* (2000), El Habbasha (2001) and Ahmed & Badr (2004) revealed that Sakha-93 surpassed the other evaluated cultivars (Giza-158, Giza-163, Giza-164, Sakha-69) in growth, yield and yield components. El Kholly & Gaballah (2005) stated that Sakha-93 surpassed Giza-168 cultivar either under normal irrigation or under water stress.

Increasing wheat yield by combined effect of bio-organic and chemical fertilizers is a promising goal in wheat production in sandy soil for improving soil properties, these benefits reported by Nour *et al.* (1989), Abdel-Magid *et al.* (1995), Fares (1997), Mikhaeel *et al.* (1997), Sushila *et al.* (2000), Zeidan & El Kramany (2001), Radwan *et al.* (2002), Kabesh *et al.* (2009) and Sary *et al.* (2009).

The objective of this study was to investigate the effect of three biofertilizers (yeast; cerealine; control) and four rates of organic manure in the form of sheep manure (without; 10; 20 and 30 m<sup>3</sup>/feddan) on yield and yield components of two wheat varieties (Gemiza-7 and Sakha-93).

### Materials and Methods

Two field experiments were carried out during winter season of 2006/2007 and 2007/2008 in the farm of the Agriculture College (Saba Basha), of the Alexandria University, Alexandria Governorate, Egypt. The experimental soil was analyzed according to Jackson (1960) and had the following mechanical and chemical characters in both seasons (Table 1-a).

**TABLE 1-a. Some physical and chemical analyses of the used soil during the two seasons.**

Physical and chemical properties	First season	Second season
Sand%	14.9	12.3
Silt %	38.8	36.4
Clay%	46.3	51.3
Soil texture	clay loam	clay loam
E.C. dS/m	0.66	0.60
pH	8.15	8.05
Ca CO <sub>3</sub> %	1.7	1.58
Organic matter%	1.96	2.24
N %	0.15	0.17
P ppm	16.2	18.6
K mg/kg soil	389	410

The Experimental treatments can be described as follows:-  
A-Main plots (cultivars): 1- Gemiza- 7.      2- Sakha- 93.

- B- Sub plots (bio-fertilizers): 1- Cerealine – commercial product contains *Azospirillum* sp. produced by General Organization of Agriculture, Egypt.  
2- Yeast. (*Candida tropicalis*) 3- Control
- C- Sub-sub plots (Organic manure in the form of sheep manure): zero, 10 m<sup>3</sup>/fed, 20m<sup>3</sup>/fed and 30 m<sup>3</sup>/fed. Composition of organic manure presented in Table 1-b.

**TABLE 1-b. Composition of the organic manure (sheep manure),**

Composition	Moisture %	Organic matter (%)	Total N (%)	Total P (%)	Total K (%)	pH
Sheep manure	65.6	36.0	1.44	0.60	1.00	7.28

The biofertilization treatment with yeast (*Candida tropicalis*) was applied before cultivation where wheat seeds were inoculated with the biofertilizer yeast (*Candida tropicalis*) loaded on sterilized peatmoss. Firstly, wheat seeds were mixed well with the Arabic gum, then spread in a shadow place for 10 min. Wheat seeds were mixed carefully with the tested inoculums-Germany.

Experimental field prepared through 2 ploughing and leveling then divided to experimental plots 3 x 3.5 m = 10.5 m<sup>2</sup> (1/400 fed). Experimental area divided to 2 equal parts for the main plots (cultivars). Each main plot divided to 3 sub-plots (bio-fertilizers) allocated randomly, then organic fertilizer rates randomly allocated in sub sub-plots in 3 replicates. Starter dose of NPK single element (35:15:24 kg/fed) was added in the form of ammonium nitrate 33% N at 21 days after sowing DAS, super phosphate 15.5% P<sub>2</sub>O<sub>5</sub> before sowing, potassium sulphate 48% K<sub>2</sub>O (21 DAS). Dry grains of wheat variety Gemiza-7 and Sakha-93 obtained from Ministry of Agriculture, Egypt at rate of 70 kg/fed divided to three parts, 1/3 without bio-treatment, 1/3 mixed with cerealine contains *Azospirillum* strain and 1/3 mixed with yeast. Sowing dates were 29 and 27 November; harvest dates were 23 and 15 May for the two seasons, respectively.

#### *Data recorded on yield and yield components*

At harvest two central rows from each plot were harvested and sub samples of ten plants were taken randomly to estimate the following yield components: 1- Number of spikes/m<sup>2</sup>. 2-Spike length (cm). 3-Spike weight (g). 4-Number of grains/spike. 5- Weight of 1000-grains (g).

All plants of each plot were harvested to determine:- 1-Grain yield (kg/fed). 2-Straw yield (kg/fed). 3-Biological yield (kg/fed). 4-Harvest index% = grain yield/biological yield x100.

#### *Statistical analysis*

Data were statistically analyzed according to Snedecor & Cochran (1990). The combined analysis was conducted for the data of two seasons. The least significant differences (LSD at 5%) used to compare the treatments means.

## Results and Discussion

### *Effect of cultivars*

Data presented in Table 2 show significant differences between the two cultivars in yield and yield components except for spike length (cm) and weight of 1000-grains (g). Gemiza-7 cultivar surpassed Sakha-93 cultivar in spike length (cm), No. of grains/spike, grain yield (ton/fed), straw yield (ton/fed), biological yield (ton/fed) and harvest index % while Sakha-93 gave higher No. of spikes/m<sup>2</sup>, heavier spike weight (g) and weight of 1000-grains (g). The results are in general agreement with those obtained by El-Habbasha (2001), also, El Kholy & Gaballah (2005) stated the superiority of c.v Sakha-93 under Egyptian condition.

**TABLE 2. Effect of cultivars and bio-fertilizers on yield and yield components of wheat, combined of 2006/2007 and 2007/2008 seasons.**

Characters	Gemiza-7	Sakha-93	LSD (0.05)	Cerealine	Yeast	Without	LSD (0.05)
No. of spikes/m <sup>2</sup>	348.00	361.10	4.63	390.9	405.6	357.9	6.31
Spike length (cm)	10.10	10.00	N.S	10.2	10.7	9.1	0.13
Spike weight (g)	2.75	2.79	0.04	2.5	2.6	1.8	0.05
No. of grains/spike	40.95	40.35	0.30	35.5	37.1	31.2	0.17
1000-grains weight (g)	40.96	41.21	N.S	35.9	37.5	32.2	0.47
Grain yield (ton/fed)	1.86	1.66	0.02	1.7	1.9	1.4	0.02
Straw yield (ton/fed)	2.69	2.48	0.03	2.7	2.8	2.4	0.02
Bio-yield (ton/fed)	4.54	4.14	0.02	4.4	4.7	3.8	0.08
Harvest index (%)	40.97	40.10	0.03	38.9	39.4	35.8	0.16

### *Effect of bio-fertilizers*

Table 2 shows clear comparison between the three types of bio-fertilizers cerealine, yeast and control (without). Results show that the differences were significant in yield and all yield components characters. Application of yeast had superiority in all the studied characters, this may be due to the bio stimulating effect of yeast on the growth of wheat via the improving of the uptake of nutrients and water from the soil, these results agreed with that obtained by Mekki & Ahmed (2005), also, Kabesh *et al.* (2009) and Sary *et al.* (2009) reported the excellent effect of bio-fertilizer cerealine for improving growth of wheat plants and increased yield and all yield components.

*Effect of organic fertilizer rates*

It is revealed from data in Table 3 that the differences between the four rates of organic fertilizer were significant for grain yield and all yield components, where the addition of 30 m<sup>3</sup>/fed gave the highest No. of spikes/m<sup>2</sup> and No. of grains/spike, the tallest spikes, the heaviest spikes, the heaviest weight of 1000-grains, the highest grain, straw, biological yields and the highest harvest index (%).

**TABLE 3. Effect of organic fertilizer rates on yield and yield components of wheat, combined of 2006/2007 and 2007/2008 seasons.**

Treatments	0 (m <sup>3</sup> /fed)	10 (m <sup>3</sup> /fed)	20 (m <sup>3</sup> /fed)	30 (m <sup>3</sup> /fed)	LSD (0.05)
Yield components					
No. of spikes/m <sup>2</sup>	326.3	360.7	376.35	388.4	3.15
Spike length (cm)	9.05	9.85	10.34	10.75	0.09
Spike weight (g)	1.96	2.39	2.59	2.88	0.04
No. of grains/spike	32.01	35.26	37.95	40.95	0.57
1000-grains weight (g)	31.03	35.87	39.07	41.97	0.69
Grain yield (ton/fed)	1.29	1.50	1.73	1.97	0.02
Straw yield (ton/fed)	2.22	2.45	2.66	2.87	0.03
Bio-yield (ton/fed)	3.51	3.95	4.59	4.87	0.06
Harvest index (%)	36.75	37.97	37.70	40.70	0.12

It's cleared from Table 3 that the addition of 30 m<sup>3</sup>/fed of organic fertilizer produced significant differences in all the studied characters comparing with the other levels of organic fertilizer, this may be due to the effect of organic fertilizer on the soil like increasing water holding capacity and nitrogen release into the soil and consequently enhancing the growth of the plant.

There was an agreement with the results obtained by Zeidan & El-Karamany (2001), also, Kabesh *et al.* (2009) and Sary *et al.* (2009) reported significant increase in yield and most yield attributes of wheat due to increasing rates of organic manure up to 30 m<sup>3</sup>/feddan .

*Effect of interaction*

Data presented in Table 4 show that the interaction between Sakha-93 and yeast significantly surpassed all other interactions in all studied characters.

Table 5 show significant differences between interactions for all studied characters except for the weight of 1000-grains. Data presented in Table 5 show that interaction between c.v. Sakha-93 and 30 m<sup>3</sup>/fed had the superiority in all studied characters compared to other interactions.

It is clear from the data in Table 6 that the interaction of yeast and 30 m<sup>3</sup>/fed recorded the best result in all studied characters and the differences were significant in all studied characters except weight of 1000-grains which had insignificant differences.

**TABLE 4.** Effect of interaction between cultivars and bio-fertilizers, combined of 2006/2007 and 2007/2008 seasons.

Cultivars	Gemiza-7			Sakha-93			LSD (0.05)
	Cerealine	Yeast	Without	Cerealine	Yeast	Without	
No. of spikes/m <sup>2</sup>	362	372	348	371	390	336	7.2
Spike length (cm)	9.0	10.7	8.9	10.5	11.6	8.7	0.15
Spike weight (g)	2.6	2.7	2.2	2.8	3.0	2.0	0.06
No. of grains/spike	37.9	39.1	34.3	39.4	41.5	33.2	0.40
1000 grains weight(g)	37.8	39.2	35.8	39.9	41.6	33.9	0.64
Grain yield (ton/fed)	1.7	1.8	1.4	1.9	2.2	1.3	0.01
Straw yield (ton/fed)	2.6	2.8	2.3	2.8	3.1	2.1	0.03
Bio-yield (ton/fed)	4.3	4.6	3.6	4.7	5.3	3.4	0.07
Harvest index (%)	39.4	39.9	37.6	40.3	40.8	37.1	0.15

**TABLE 5.** Interaction between cultivars and organic fertilizer rates, combined analysis of 2006/2007 and 2007/2008 seasons.

Cultivars	Gemiza 7				Sakha 93				LSD at (0.05)
	0 m <sup>3</sup> /fed	10 m <sup>3</sup> /fed	20 m <sup>3</sup> /fed	30 m <sup>3</sup> /fed	0 m <sup>3</sup> /fed	10 m <sup>3</sup> /fed	20 m <sup>3</sup> /fed	30 m <sup>3</sup> /fed	
No. of spikes/m <sup>2</sup>	330	366	378	395	334	365	382	404	3.25
Spike length (cm)	8.8	9.5	9.9	10.4	8.9	10.0	10.3	10.8	0.12
Spike weight (g)	1.9	2.2	2.5	2.7	2.0	2.5	2.8	3.1	0.06
No. of grains/spike	31.8	34.9	37.6	39.8	32.2	35.6	38.3	42.1	0.66
1000-grains weight (g)	30.7	35.7	38.6	40.7	31.3	36.0	39.6	42.2	N.S
Grain yield (ton/fed)	1.3	1.4	1.7	1.9	1.3	1.5	1.7	2.1	0.04
Straw yield (ton/fed)	2.2	2.4	2.7	2.8	2.2	2.5	2.6	3.1	0.03
Bio-yield (ton/fed)	3.5	3.8	4.4	4.6	3.5	4.1	4.4	5.2	0.08
Harvest index	36.6	37.8	39.2	40.5	37.0	38.3	39.8	41.0	0.13

**TABLE 6. Interaction between bio-fertilizers and organic fertilizer rates on yield and yield components of wheat, combined analysis of 2006/2007 and 2007/2008 seasons.**

Treatments		1	2	3	4	5	6	7	8	9
Cereasiline	0 m <sup>3</sup> /fed	344	9.2	2.0	33.5	31.8	1.4	2.3	3.7	37.8
	10 m <sup>3</sup> /fed	370	9.8	2.6	35.9	36.9	1.6	2.5	4.1	9.8
	20 m <sup>3</sup> /fed	385	10.3	2.7	39.3	39.6	1.8	2.8	4.6	39.9
	30 m <sup>3</sup> /fed	398	10.7	3.3	42.0	42.5	2.1	3.0	5.1	41.3
Yeast	0 m <sup>3</sup> /fed	354	9.8	2.1	34.4	34.1	1.5	2.4	3.8	38.1
	10 m <sup>3</sup> /fed	379	10.6	2.8	37.8	38.0	1.8	2.8	4.6	39.3
	20 m <sup>3</sup> /fed	395	11.1	3.2	40.3	41.2	2.0	2.9	4.9	40.4
	30 m <sup>3</sup> /fed	416	11.7	3.4	44.4	43.8	2.4	3.3	5.7	41.7
Without	0 m <sup>3</sup> /fed	298	6.8	1.6	28.2	27.2	1.0	1.9	3.0	34.1
	10 m <sup>3</sup> /fed	347	8.6	2.1	32.0	32.7	1.1	2.1	3.2	35.4
	20 m <sup>3</sup> /fed	361	8.7	2.7	34.3	36.4	1.4	2.2	3.6	37.9
	30 m <sup>3</sup> /fed	367	9.6	2.8	36.5	38.1	1.5	2.3	3.8	40.0
LSD (0.05)		4.58	0.16	0.08	0.82	N.S	0.02	0.04	0.11	0.16

1= Number of spikes/m<sup>2</sup>.

2=Spike length (cm).

3=Spike weight (g).

4=No. of grains/spike.

5= 1000-grains weight (g).

6= Grain yield (ton/fed).

7= Straw yield (ton/fed).

8= Bio-yield (ton/fed).

9= Harvest index (%).

Data presented in Table 7 show significant differences between interactions of the three factors in all studied characters except No. of grains/spike and weight of 1000-grains. Interaction between Sakha-93 x Yeast x 30 m<sup>3</sup>/fed recorded the first order in all studied characters.

The obtained results are in general agreement with those obtained by Radwan *et al.* (2002) and Sushila *et al.* (2000).

**TABLE 7. Effect of interaction between cultivars, bio-fertilizers and organic fertilizer rates.**

Cultivars	Bio-fertilizers	Org-fertilizer rates (m <sup>3</sup> /fed)									
			1	2	3	4	5	6	7	8	9
Gemiza-7	Cerealine	0	339	9.1	1.9	33	30.9	1.33	2.23	3.57	37.4
		10	365	9.5	2.5	35	36.0	1.50	2.42	3.92	38.2
		20	378	9.9	2.6	39	38.7	1.76	2.71	4.47	39.4
		30	388	10.6	2.8	40	40.9	1.90	2.81	4.71	40.3
	Yeast	0	348	9.7	2.1	34	33.2	1.41	2.32	3.73	37.8
		10	375	10.4	2.6	37	37.1	1.69	2.64	4.32	39.0
		20	388	10.9	2.8	39	39.6	1.96	2.95	4.91	40.8
		30	398	11.3	3.0	42	42.3	2.05	2.97	5.01	34.3
	Without	0	304	7.6	1.7	29	28.1	1.06	2.04	3.10	35.7
		10	358	8.6	2.0	32	34.0	1.19	2.14	3.32	38.3
		20	368	9.2	2.2	35	37.5	1.44	2.33	3.77	39.1
		30	372	9.5	2.5	37	39.0	1.51	2.35	3.86	37.4
Sakha-93	Cerealine	0	349	9.6	2.2	34	32.7	1.33	2.23	3.57	38.2
		10	375	10.2	2.7	37	37.8	1.50	2.42	3.92	39.4
		20	392	10.6	2.9	40	40.5	1.78	2.71	4.47	40.3
		30	407	11.0	3.3	44	44.1	1.90	2.81	4.71	37.8
	Yeast	0	361	10.1	2.4	35	35.0	1.41	2.32	3.73	39.0
		10	383	11.1	2.8	39	38.9	1.68	2.64	4.32	39.9
		20	401	11.7	3.1	41	42.9	1.96	2.95	4.91	40.0
		30	434	12.2	3.5	47	34.3	2.05	2.97	5.01	40.8
	Without	0	292	7.2	1.5	28	26.3	1.06	2.04	3.10	34.3
		10	336	8.3	1.8	32	31.3	1.19	2.14	3.32	35.7
		20	353	8.9	1.9	34	35.4	1.44	2.33	3.77	38.3
		30	362	9.3	2.2	36	37.2	1.51	2.35	3.87	39.1
LSD (0.05)			7.81	0.25	0.11	N.S	N.S	0.03	0.05	0.15	0.23

1= Number of spikes/m<sup>2</sup>.

2=Spike length (cm).

3=Spike weight (g).

4=No. of grains/spike.

5= 1000-grains weight (g).

6= Grain yield (ton/fed).

7= Straw yield (ton/fed).

8= Bio-yield (ton/fed).

9= Harvest index (%).

### Conclusion

Results obtained clear that Sakha-93 gave higher yield and yield components than Gemiza-7; yeast was the best bio-treatment and 30 m<sup>3</sup>/fed sheep manure had superiority on the other organic fertilizer rates. It can be concluded that the results of the interactions between the three factors may be due to the combination between Sakha-93 and 30 m<sup>3</sup>/fed sheep manure as a suitable rate of organic fertilizer which in turn on yield and most yield attributes, also, the effect of bio-fertilization by yeast (*Candida tropicalis*) on enhancing growth of wheat plant and gave best release of nutrients from sheep manure, the three factors act together and reflected on yield and most yield attributes.

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## تأثير التفاعل بين التسميد البيولوجي و العضوى على محصول ومكونات صنفين من القمح

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اجريت تجسرتين حقليتين خلال الموسمين الشتويين ٢٠٠٧/٢٠٠٦ و ٢٠٠٨/٢٠٠٧ بمزرعة كلية الزراعة- ساجا باشا - الاسكندرية لدراسة تأثير ثلاثة معاملات من التسميد الحيوى ( المقارنة- مركب تجارى Cerealine يحتوى على *Azospirillum spp.* - الخميرة Yeast تحتوى على النوع *Candida tropicalis* ) وأربعة معدلات من التسميد العضوى ( المقارنة- ١٠-٢٠-٣٠ م<sup>٢</sup> / فدان ) على صنفين من محصول القمح و مكوناته (جميزة ٧- سخا ٩٣) . أجريت التجربة فى تصميم القطع المنشقة مرتين حيث وضعت الأصناف فى القطع الرئيسية و التسميد الحيوى فى القطع المنشقة الأولى و التسميد العضوى فى القطع المنشقة الثانية . أوضحت النتائج تفوق الصنف جميزة ٧ على الصنف سخا ٩٣ فى طول السنبله - عدد الحبوب/السنبله- المحصول البيولوجى ومحصول الحبوب والقش - دليل الحصاد. بينما تفوق الصنف سخا ٩٣ فى عدد السنابل/م<sup>٢</sup> - وزن السنبله- وزن ألف حبة. أدت اضافة السماد الحيوى فى صورة الخميرة إلى تفوق فى كل الصفات المدروسة كما أدت اضافة السماد العضوى بمعدل ٣٠ م<sup>٢</sup> / فدان إلى الحصول على أفضل النتائج فى المحصول و مكوناته. سجل التفاعل بين الصنف سخا ٩٣ و السماد العضوى بمعدل ٣٠ م<sup>٢</sup> / فدان إلى الحصول على أفضل النتائج فى المحصول و مكوناته كما تفوق التفاعل بين الخميرة و السماد العضوى بمعدل ٣٠ م<sup>٢</sup> / فدان على باقى التفاعلات كما اعطى التفاعل الثلاثى بين الصنف سخا ٩٣ والخميرة و السماد العضوى بمعدل ٣٠ م<sup>٢</sup> / فدان أفضل النتائج للصفات المدروسة.