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Effect of Sowing Methods and Some Bio-organic Fertilization Treatments on Yield and Yield Components of Wheat

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Abstract: Two field experiments were carried out during winter seasons 2004/2005 and 2005/2006 in Experimental Station of National Research Centre Shalakan District, Kalubia Governorate, Egypt. The aim of the study was to examine the effect of replacing NPK by bio-organic fertilization on yield and its components of wheat c.v Sakha 93 sown in ridges or in rows .The experiment included 10 treatments which were the combinations of two sowing methods 1- in ridges 2- rows and five bio-organic and chemical fertilization treatments which were 1- Recommended dose of bio-organic fertilizer 10 m3/fed. chicken manure and (cerealine) commercial product contain *Azospirillum* sp. 2- 75% rec. bio-organic + 25% rec. NPK 3- 50% rec. bio-organic + 50% rec. NPK. 4- 25% rec. bio-organic + 75% rec. NPK. 5- Recommended dose (100%) of NPK 75:31:48 kg/fed. The treatments were arranged in split plot design in four replicates, sowing methods in main plots and fertilization treatments in subplots. Combined analysis used for the two seasons. Data indicated that sowing wheat c.v Sakha-93 in ridges surpassed in rows for no. of tillers; spikes/m2; spike length; spike weight ; grains weight/spike; grain; straw; biological yields as kg/fed.; harvest index %; protein; phosphorus and K yields as kg/fed. On the other hand, sowing in rows produced taller plants, heavier 1000 grains weight. Due to fertilization treatments combined of 25 % rec. bio-organic fert. + 75 % rec. NPK gave the best results for all studied characters except for plant height. Interaction of sowing in ridges x 25 % rec. bio-organic fert. + 75 % rec. NPK recorded the first order in most studied characters except for grain; straw; biological- yields/fed. interaction of sowing in ridges x 100 % NPK was the best and in rows x 25 % rec. bio-organic fert. + 75 % NPK produced the heaviest 1000 grains weight.

Key words: Wheat, sowing methods, bio-organic fertilization, Egypt.

INTRODUCTION

Wheat is the worlds most important and most widely grown cereal crop through many properties and uses of its grains and straw. Increasing grain yield of wheat is an important national goal to face the continious 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 achived by increasing wheat area from 1.83 to 2.71 million fed/year and grain yield from 1.50 to 2.71 ton/fed. in the same period[7]. Plant density; sowing methods; fertilization; weed and diseases control are among the limited factors of wheat production. To obtain high yield of wheat, sowing method is one of the important factors which compensates the low tillering in wheat, to give the best plant distribution in the field and to save the labor in controlling weeds within ridges or rows[12,19,23,11,16,3]. The benefits of bio-organic fertilizers for increasing wheat grain yield are not always easy to optimize because of N content and its subsequent release being difficult to predict. Increasing wheat yield by combined effect of bio-organic and chemical fertilizers is a promising goal in wheat production for decreasing high doses of chemical fertilizer also, get more clean product with low undersirable high doses of heavy metals and other pollutants, these benefits reported by[15,1,8,13,22,27,18].

The objective of this study was to investigate the effect of two sowing methods and five combinations of bio-organic and chemical fertilizers on yield and yield components of wheat c.v Sakha 93.

MATERIALS AND METHODS

Two field experiments were carried out during winter season of 2004/2005 and 2005/2006 in the Experimental Station of National Research Centre, Shalakan District, Kalubia Governorate, Egypt. The experimental soil before sowing had the following mechanical and chemical characters in both seasons sand14.9-12.3%; silt 38.8-36.4%; clay 46.3-51.3%;

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texture clay loam; Ca co3 1.7-1.58%; organic matter 1.96-2.24%; EC 0.66-0.60 mmhos/cm3; ph 8.15-8.05 ; N 0.15-0.17%; P 16.2-18.6 ppm; K 389-410 mg/kg soil.

The Experimental treatments can be described as follows:-

A- Main plots (sowing methods)

1- In ridges – dry grains in hills 10cm between on both sides of ridges 60 cm apart.

2- In rows – dry grains drilled in rows 15 cm apart.

B- Sub plots (bio-organic fertilization)

1- 100% recommended dose of organic fertilizer (10m3/fed.) chicken manure + **(cerealine) biofertilizer

2- 75% bio-organic + 25% NPK.

3- 50% bio-organic + 50% NPK.

4- 25% bio-organic + 75% NPK.

5- 100% recommended dose of chemical fertilizers NPK (75-31-48) kg/fed.

***(Chicken manure**) had the following chemical compositions:- organic matter 49.2-51.5%; organic carbon 29-29.4%; C/N ratio 14-14.08; pH 7.45-7.75; EC 2.2 mmhos/cm3; N 2.01-2.15% ; P 112-124 ppm ; K 101-115 ppm in both seaqsons.

****(Cerealine)** is a commercial product of biofertilizer contains *Azospirillum* sp. produced by General Organization of Agriculture, Egypt.

Experimental field prepared through 2 ploughing and leveling then divided to experimental plots 3 x 3.5 m= 10.5 m^2 (1/400 fed.). Experimental area divided to 2 equal parts for the main plots (sowing methods), the first for ridges 60 cm apart and the second for rows 15 cm between. Each main plot divided to 5 sub-plots, then bio-organic fertilization treatments randomly allocated in sub-plots.

Organic manure at the source of chicken manure was added at the rate of 0; 2.5; 5.0; 7.5 and 10 m3/feddan according to treatments which were 0,25,50,75 and 100% of the recommended dose (10 m3/fed.) from chicken manure mixed with the soil surface layer before sowing. Chemical fertilizers NPK at 0,25,50,75 and 100% of recommended dose (75:31:48) were applied according to the treatments. The forms of NPK was (N) ammonium nitrate 33.5% N; (P) calcium superphosphate 15.5% p2o5 and (K) potassium sulphate 48% k2o , P and K added during tillage operation before sowing and N added at two portions at 35 and 49 DAS.

Dry grains of wheat variety Sakha-93 obtained from Ministry of Agriculture, Egypt at rate of 45 kg/fed. divided to five parts fifth without bio-treatment and 80% of the quantity mixed with sack of (cerealine) contains *Azospirillum* sp. strain. Sown dates were 29 and 27 November; harvest dates were 23 and 15 May for the two seasons, respectively.

A- Yield and yield components: At harvest two central ridges or rows from each plot were harvested and sub samples of ten plants were taken randomly to estimate the following yield components:

1- Plant height (cm). 2-Number of tillers/m2. 3-Number of spikes/m2. 4-Spike length (cm). 5-Spike weight (g). 6-Weight of grains/spike. 7-1000-grains weight (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.

B- Chemical composition of wheat grains: Samples of grains were taken from the grain yield of each plot for chemical analysis. Total N, P and K contents in grains were determined according to[4]. Chapman and Pratt (1978). Crude protein calculated by N % x 5.75. Protein, phosphorus and potassium yield (kg/fed.) calculated by multiply protein %, P % and K % by grain yield (kg/fed.).

Statistical analysis: Data were statistically analyzed according to Snedecor and 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.

Feddan = 4200 m^2.

RESULTS AND DISCUSSION

Effect of sowing methods:

Yield and yield components: Data presented in Table (1) revealed the differences between sowing methods in ridges and in rows for yield and yield components. It is clear that there were significant differences between the two studied sowing methods for all studied characters except for plant height; spike length and 1000-grains weight.

Sowing wheat in ridges produced the greater number of tillers/m2; no. of spikes/m2; taller spikes; the heaviest spike weight (g); weight of grains/spike (g); grain yield (kg/fed.); straw yield (kg/fed.); biological yield (kg/fed.) and the higher harvest index %. Sowing wheat in rows gave the taller plants and heavier 1000-grains weight than sowing in ridges. Results are in harmony with obtained by [6,19,23,11].

Chemical composition of wheat grains: Data in Table 2 show insignificant differences between sowing methods for N, P, K% in grains. It is clear from data

presented in the same table that sowing method in ridges gave higher protein yield (kg/fed.); Phosphorus yield (kg/fed.) and potassium yield (kg/fed.) than sowing in rows. Results were in confirmed with those obtained by[16,3].

Table 1: Effect of sowing methods treatments on yield and yield components of wheat. (Combined analysis of 2004/2005 and 2005/2006 seasons).

Characters Treatments	Plant height (cm)	No. of Tillers/m²	No. of spikes/m²	Spike length (cm)	Spike weight (g)	Weight of grains/spike (g)	1000-grains weight (g)	Grain yield kg/fed.	Straw yield kg/fed.	Biological yield kg/fed.	Harvest index %
Ridges	91.3	469.4	304.2	13.4	3.11	2.05	49.02	2126	4628	6754	31.50
Rows	93.5	446.4	283.2	13.2	3.06	1.98	49.24	1923	4436	6359	30.30
L.S.D. at 5%	N.S.	13.3	5.4	N.S	0.04	0.06	N.S.	34	80	95	0.42

Table 2: Effect of sowing methods treatments on wheat grain protein, phosphorus and potassium yield (kg/fed) . (Combined analysis of 2004/2005 and 2005/2006 seasons)

Sowing methods treatments	Protein		Phosphorus		Potassium	
%	Yield (kg/fed.)	%	Yield (kg/fed.)	%	Yield (kg/fed.)	
Ridges	11.75	249.80	0.293	6.22	0.863	18.66
Rows	11.46	220.37	0.298	5.73	0.872	16.76
L.S.D. at 5%	N.S.	3.90	N.S.	0.10	N.S.	0.30

B- Effect of bio-organic fertilization treatments:

Yield and yield components: It is revealed from data in Table (3) that the differences between bio-organic fertilization treatments were significant for all studied characters except for plant height and 1000-grain weight. Treatment of 25% rec. dose of bio-organic fert. + 75% rec. NPK produced the highest no. of tillers/m2; no. of spikes/m2; the tallest spikes; heaviest spikes; highest grain weight/spike; heaviest 1000-grains; the highest grain, straw, biological yields per feddan, also, the greatest harvest index %.

Chemical composition of wheat grains: Table 4 clear that the differences between bio-organic fertilization treatments were insignificant due to percentage of protein, P, K but there were significant differences in P, K yields (kg/fed.). Treatment of 100 % rec. NPK recorded superiority in P yield (kg/fed.). Treatment of 25 % rec. bio-organic +75 % rec. NPK surpassed other treatmentws in protein yield (kg/fed.) and K yield (kg/fed.). These results are in harmony with those obtained by[17,26,8,9,27,2,25,24].

Effect of interaction between sowing methods and bio-organic fertilization.

Yield and yield components: Data presented in Table 5 revealed that the significance cleared in no. of spikes/m2; grain, straw, biological yields per feddan. Interaction between sown in ridges x 25% rec. bio-organic + 75% rec. NPK gave the highest no. of tillers/m2; no. Of spikes/m2; spike length; grain weight of spike and harvest index %. Results are in accordance with those obtained by[26,13,8,14,20,5,9,27,18,25,24]. Interaction between sown in ridges x 100 % rec. NPK produced the greatest yields of grains, straw and biological yields per feddan. Interaction of sown in rows x 25 % rec. organic fert. + 75 % rec. NPK recorded the tallest plants, the highest spike weight and the heaviest 1000- grains.

Chemical composition of wheat grains: It is clear from data in Table 6 that the differences between interactions were insignificant in protein, P, K % but significant in yield content in grains (kg/fed.).

Table 3: Effect of bio-organic fertilization treatments on yield and yield components of wheat.

Characters Treatments	Plant height (cm)	No. of tillers/m²	No. of spikes/m²	Spike length (cm)	Spike weight (g)	Grain weight/ spike (g)	1000-grains weight (g)	Grain yield kg/fed.	Straw yield kg/fed.	Biological yield kg/fed.	Harvest index %
F_1 Org. 100 %	91.9	435.8	264.8	12.9	2.97	1.96	48.36	1875	4324	6199	30.8
F_2 Org. 75 % + Chem. 25 %	92.8	441.0	273.8	12.9	3.04	2.00	49.00	1894	4389	6283	30.3
F_3 Org. 50 % + Chem. 50 %	92.4	455.8	292.2	13.3	3.08	2.02	49.37	2001	4485	6486	31.1
F_4 Org. 25 % + Chem. 75 %	93.9	479.2	320.4	13.5	3.18	2.06	49.58	2186	4727	6913	31.6
F_5 Chem. 100 %	94.0	477.4	317.4	13.5	3.16	2.06	49.40	2165	4734	6899	31.4
L.S.D. at 5%	N.S	31.5	5.5	0.5	0.10	0.08	N.S.	55	77	99	0.7

Table 4: Effect of bio-organic fertilization treatments on wheat grain protein, phosphorus and potassium yield (kg/fed). (Combined analysis of 2004/2005 and 2005/2006 seasons)

Bio-organic fertilization treatments	Protein		Phosphorus		Potassium	
%	Yield (kg/fed.)		%	Yield (kg/fed.)	%	Yield (kg/fed.)
F_1	11.17	209.43	0.286	5.36	0.871	16.33
F_2	11.17	211.55	0.288	5.45	0.846	16.02

Table 4: Continue

F_3	11.93	238.72	0.303	6.06	0.896	17.92
F_4	11.86	259.26	0.298	6.51	0.863	18.86
F_5	11.90	257.64	0.302	6.53	0.866	18.74
L.S.D. at 5%	N.S.	6.38	N.S.	0.16	N.S.	0.49

Table 5: Effect of interaction between bio-organic fertilization and sowing methods on yield and yield components of wheat. (Combined analysis of 2004/2005 and 2005/2006 seasons).

Characters / Treatments		Plant height (cm)	No. of tillers/m^2	No. of spikes/m^2	Spike length (cm)	Spike weight (g)	Grain weight of spike (g)	1000-grains weight (g)	Grain yield kg/fed.	Straw yield kg/fed.	Biological yield kg/fed.	Harvest index %
Sowing methods	Bio-organic fertilization											
Ridges	F_1	91.75	446.1	276.4	12.9	3.02	2.00	48.19	1988	4442	6430	31.10
	F_2	92.85	447.7	284.9	13.0	3.07	2.02	49.31	1979	4512	6491	30.70
	F_3	91.00	460.0	298.7	13.6	3.12	2.06	49.27	2076	4552	6628	31.60
	F_4	93.70	495.8	331.0	13.6	3.16	2.09	49.17	2289	4766	7055	32.30
	F_5	93.95	492.7	330.2	13.7	3.17	2.09	49.20	2298	4867	7165	32.10
Rows	F_1	91.98	425.5	253.3	12.9	2.93	1.91	48.53	1763	4207	5970	29.75

Table 6: Effect of interaction between bio-organic fertilization and sowing methods treatments on wheat grain protein, phosphorus and potassium yield (kg/fed). (Combined analysis of 2004/2005 and 2005/2006 seasons)

Treatments		Protein		Phosphorus		Potassium	
Sowing methods	Bio-organic fertilization	%	Yield (kg/fed.)	%	Yield (kg/fed.)	%	Yield (kg/fed.)
Ridges	F_1	11.19	222.45	0.284	5.64	0.866	17.21
	F_2	11.23	222.24	0.284	5.62	0.833	16.48
	F_3	12.21	253.47	0.299	6.2	0.905	18.78
	F_4	12.03	275.36	0.298	6.82	0.861	19.7
	F_5	12.11	278.28	0.299	6.87	0.855	19.64
Rows	F_1	11.15	196.57	0.288	5.09	0.875	15.42
	F_2	11.11	200.97	0.292	5.28	0.860	15.55
	F_3	11.65	224.49	0.307	5.91	0.888	17.11
	F_4	11.69	243.60	0.298	6.21	0.874	18.21
	F_5	11.69	237.54	0.306	6.19	0.877	17.82
L.S.D. at 5%		N.S.	9.02	N.S.	0.23	N.S.	0.68

Interaction of sown in ridges x 50% rec.bio-organic fert.+ 50% rec. NPK produced the highest protein and phosphorus yield (kg/fed.).

Interaction of sowing in ridges x 25% rec. bio-organic fert. + 75 % rec.NPK gave the greatest K yield/fed.

Interaction sowing in rows x 50% rec. bio-organic fert. + 50% rec. NPK recorded the highest P % but non-significant.

Conclusion: It is clear from results that sowing wheat Sakha-93 in ridges method produced the higher grain yield/fed. and for most of yield attributes. It can be concluded that these superiority may be due to the excellent plant distribution in the field which reflected on best conditions of space, light, air and high response to fertilization in turn on yield and most yield attributes.

Due to fertilization treatments there were superiority for treatment of 25 % rec. bio-organic fert. + 75 % rec. NPK in grains; straw; biological yields/fed. and for most yield attributes. It can be concluded that the superiority may be due to the fast effect of NPK in chemical form at beginning period of plant growth followed by the stimulate effect of bio-organic fertilizer through flowering and grain production.

Finally, it can be concluded that sowing wheat grains cv. Sakha-93 in ridges sowing method and fertilized by 75 % rec. dose of NPK + 25 % rec. dose of bio-organic fertilizer (chicken manure) can be increase yield, its components, protein, P, K in grains.

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