Journal of Applied Sciences Research, 3(10): 1121-1126, 2007

Growth and Yield of Some Wheat Cultivars Irrigated with Saline Water in Newly Cultivated Land as Affected by Biofertilization

[1]Nabila, M. Zaki, M.S. Hassanein and Karima [2]M. Gamal El-Din

[1]Field Crops Research Department. National Research Centre, Dokki, Cairo, Egypt.
[2]Botany Department, National Research Centre, Dokki, Cairo, Egypt.

Abstract: A field experiment was performed during the two consecutive winter seasons of 2004 / 2005 and 2005 / 2006 to study the effect of biofertilizers Azospirillum and yeast (Candila) and their interaction, in the presence of the half recommended dose of NPK, on yield and its components of some wheat cultivars grown in newly cultivated land. The various biotreatments supported with 50 % NPK, while control was supported with the recommended dose of NPK. The results could be summarized as follows Wheat cultivars, i.e. (Sakha-93, Gemiza-7 and Gemiza-9) significantly differed in all growth characters under study at 120 days from sowing. Biotreatments produced significant increments in all growth characters under study. The effect of interaction between wheat cultivars and biotreatments showed a significant effect on all growth characters under study. The results showed that wheat cultivars significantly affected yield and its components except harvest index. There were significant differences for yield and its components except harvest index owing to biotreatments. The interaction between wheat cultivars and biotreatments showed a significant effect on plant height, No. of spike / m^2, spike length, No. of grains / spike, weight of grains / spike, 1000 grains weight, grain yield / fed., straw yield / fed. and biological yield / fed.

Key Words:

INTRODUCTION

Wheat (*Triticum aestivum*, L.) is one of the most important cereal crop in Egypt and over all the world used in human food and animal feed. Wheat provides 37 % of the total calories for the people and 40 % of the protein in the Egyptian diet (Min. Agric. Statistic Year Book, 2000). The total production of wheat in Egypt reached 8184 million tons in 2006. Produced from an area of 3.004 million feddan (Monthly Economic Bulletin 2006). With an average yield of 6.7 ton/ha. Recently, a great attention of several investigators has been directed to increase the productivity of wheat to minimize the gap between the Egyptian production and consumption by increasing wheat production through increasing unit land area productivity and increasing cultivated area.

Increasing wheat yield per unit area can be achieved by breeding high yielding varieties and applying the optimum cultural practices such as organic fertilization which reduce pollution and sustain soil fertility through their effect on the physical, chemical and biological properties of soil, but its use alone is not sufficient to meet the requirement of nutrients. So, using nitrogen fixation bacteria such as (Azospirillum) assume a greater importance. Therefore it can fix atmospheric nitrogen to supply plants with part of nitrogen – requirement to reduce the amount of N-chemical fertilizer, production costs and environmental pollution.

Increasing wheat yield per unit area can be achieved by breeding high yielding varieties. Wheat cultivars differed in growth characters,[1,6].

Wheat cultivars differed in yield and its components,[7,8,9,2]. Grain, straw and biological yields and its components were significantly differed owing to varietal differences[4,6].

Many investigators found that inoculation of wheat grains with Azospirillum significantly enhanced the growth of wheat plants, yield and its components were increased[10,12]. Also adding yeast to Millet and increased yield and its components[13].

The aim of this investigation was designed to study the effect of wheat cultivars as well as biofertilizers i.e. *Azospirillum liproferum* and yeast (*Candila tropicalis*) and their combinations on growth, yield and yield components of wheat in newly cultivated land, in the presence of 50% of the recommended doses / fed. of (NPK) comparing the results against those obtained by the recommended doses of chemical fertilizers (100 % NPK / fed.).

Corresponding Author: Nabila, M., Field Crops Research Department, National Research Centre, Dokki, Cairo, Egypt.

MATERIALS AND METHODS

Two field experiments were carried out in newly cultivated lands under sandy soil at Shandura, Kabrit, Suez governorate, during the two successive seasons 2004/2005 and 2005/2006 to study the response of growth, yield and yield components of some wheat cultivars to biofertilizers i.e (Azospirillum and yeast). Soil and water analysis are presented in Table 1.

Each experiment included 12 treatments which were the combination between three wheat cultivars (Sakha-93, Gemiza-7 and Gemiza-9) and three treatments with biofertilizers (Azospirillum, yeast and Azospirillum + yeast).

The experiments were laid in a split plot design with four replications, where, wheat cultivars occupied the main plots and biotreatments were allocated at random in sub plots.

The biofertilizer treatments were :

- Control (100 % NPK)
- *Azospirillum lipoferum* (Azos)
- Yeast (*Candila tropicalis* (Yeast)
- Azos + Yeast

Where all biotreatments were received 50 % of all the recommended rates of chemical fertilizers (NPK) per fed.

The experimental unit consisted of 15 rows each of 3.5 meter length and 20 cm between rows where, the size of each plot was 10.5 m^2 (1/400 fed.), seeded at a rate of 60 kg/fed. Wheat cultivars were planted on 17th and 10th November in 2004 and 2005 seasons, respectively, and then inoculated with respective biofertilizers that added, in a form, directly on the seeds using 20 L. sprayers. The normal agronomic practices of growing wheat were practiced till harvest as recommended by wheat research Dept., A.R.C.

The following growth attributes at 120 days after sowing were recorded, i.e., plant height, No. of tillers / plant, No. of leaves / plant, No. of spikes / plant, Flag leaf are (cm^2) and dry weight of Leaves, tillers and spikes per plant (g).

At harvest, ten plants were taken randomly from each plot to determine plant height (cm), spike length (cm), No. of grains / spike and weight of grains / spike (g).

Sample of 1 sq.m. from each plot was harvested to determine No. of spike/ m^2, grain index (g). In addition grain yield (ton/fed.), straw yield (ton/fed.), biological yield (ton/fed.) and harvest index (grain yield / biological yield per fed.) were determined from 1 sq.m. of experimental unit and then converted to yield / fed.

Statistical analysis was performed according to Snedecor and Cochran[14]. Treatments mean were compared by L.S.D test. Combined analysis was made from the two growing seasons hence the results of two seasons followed similar trend.

RESULTS AND DISCUSSIONS

Growth characters :

Effect of cultivars: Data in Table (2) shows that cultivars Sakha-93, Gemiza-7 and Gemiza-9 significantly differed in vegetative growth characters, i.e. plant height, No. of tillers / plant, No. of leaves / plant, No. of spikes / plant, flag leaf area and also dry weight of leaves, tillers and spikes / plant.

It is clear from the data that Gemiza-9 exceeded other cultivars in all characters under study at 120 days after sowing.

It is also clear that varietal differences between Gemiza-7 and Gemiza-9 failed to reach the significant level at 0.05 except No. of leaves / plant, No. of spikes / plant and dry weight of spikes / plant.

It could be concluded that varietal differences between wheat cultivars may be due to the genetical differences between cultivars and differences genotypes concerning partition of dry matter, where wheat cultivars differed in carbon equivalent, yield energy pr plant and per feddan,[15]. The superiority of Gemiza-9 cultivar may be due to the increase in the efficiency to photosynthate of more water and minerals from soil. This reflected on increasing the production of more sizeable organs.

The results of varietal differences in growth parameters in this study are in agreement with those obtained by Hassanien *et al*.,[2], El-Habbasha[3], Hassanien[16], Zaki *et al*.,[4] and Abdel-Ati and Zaki[6].

Effect of biofertilization: It is obvious from the data presented in table (2) that plant height (cm), No. of tillers per plant, No. of leaves per plant, No. of spikes per plant, flag leaf area (cm^2) and dry weight of (leaves, tillers and spikes) per plant were significantly affected by inoculation of wheat grains with Azospirillum or yeast and/or Azos + yeast in comparison to control treatment (100 % NPK, without inoculation).

These results are in agreement with those obtained by Zambre and Konda[17] and Hossam El-Din[18]. Growth was significantly higher under the inoculation by Azos + yeast followed by yeast and the lowest was Azos compared with untreated plants. El-Khawas[19] concluded that the principle mechanism by which Azos could benefit the plant growth can going through a-fixing molecular of nitrogen and its transfer to the

Table1: Chemical analysis for soil and water.

Sample	pH	EC ppm	Soluble cations and anions meq / l.						
			Ca^{+}	Mg^{+}	Na^{+}	K^{+}	HCO_3^{-}	Cl^{-}	SO_4^{-}
Soil	7.5	2016.8	85.3	55.5	210.2	11	6.5	260	95.5
Water	7.1	2931.2	13.8	9.5	21	2	1.3	28.4	16.1

Mechanical analysis for soil							
Sand	Silt	Clay	Texture	Organic matter O.M.		Total N	Available P.
72.2 %	24.2 %	3.2 %	sandy	0.23 %	0.04 %	6.8 ppm	

Table 2: Effect of cultivars and biofertilizers on growth characters of wheat plant at 120 days after sowing (combined analysis of 2004/2005 and 2005/2006 seasons)

Characters		Plant height (cm)	No. of tillers/plant	No. of leaves/plant	No. of spikes/plant	Flag leaf area (cm^2)	Dry weight (g)		
Treatments							Leaves	Tillers	Spikes
Cultivars	Sakha-93	83.5	4.2	15.1	4.7	38.4	3.8	8.2	4.6
	Gemiza-7	95.5	4.6	16.9	5.6	43.7	4.9	9.5	5.5
	Gemiza-9	96.7	4.7	17.6	5.7	44.3	5.0	9.4	5.8
L.S.D. at 0.05		2.0	0.4	0.7	0.1	1.1	0.5	0.6	0.3
Biofertilizers	Control	88.1	3.7	14.7	4.5	39.3	3.5	8.1	4.7
	Azo.	91.7	4.3	16.2	5.1	41.6	4.4	9.0	5.1
	Yeast	93.0	4.9	17.7	5.6	43.4	5.2	9.5	5.6
	Azo.+ yeast	94.2	5.0	17.5	6.0	44.4	5.3	9.6	5.7
L.S.D. at 0.05		3.2	0.6	1.5	0.6	2.3	0.98	0.9	0.4

Table 3: Effect of interaction between cultivars and biofertilizers on growth characters of wheat plant at 120 days after sowing (combined analysis of 2004/2005 and 2005/2006 seasons)

Treatments	Characters	Plant height (cm)	No. of tillers/plant	No. of leaves/plant	No. of spikes/plant	Flag leaf area (cm^2)	Dry weight (g)		
Cultivars	Biofertilizers						Leaves	Tillers	Spikes
Sakha-93	Control	81.3	3.5	13.0	3.9	35.7	2.9	7.0	4.01
	Azo.	83.5	4.2	15.2	4.5	37.9	3.7	8.1	4.32
	Yeast	84.1	4.5	16.3	5.0	39.5	4.2	8.7	5.00
	Azo.+ yeast	85.1	4.8	16.1	5.6	40.6	4.5	8.9	5.03
Gemiza-7	Control	90.3	3.8	15.0	4.7	41.2	3.6	8.9	5.00
	Azo.	95.3	4.2	16.2	5.5	43.0	4.7	9.3	5.40
	Yeast	96.7	5.1	18.1	5.9	45.0	5.9	9.9	5.80
	Azo.+ yeast	97.9	5.2	18.0	6.2	45.9	5.6	10.0	5.90
Gemiza-9	Control	92.7	3.9	16.0	5.0	41.0	4.0	8.3	5.20
	Azo.	96.3	4.5	17.3	5.4	44.0	4.9	9.5	5.70
	Yeast	98.1	5.3	18.6	6.0	45.7	5.6	9.9	5.90
	Azo.+ yeast	99.5	5.0	18.5	6.3	46.6	5.5	9.9	6.30
L.S.D. at 0.05		3.5	0.9	2.5	0.9	3.0	1.0	1.3	1

plant as direct effect or b- production of plant growth hormones (Auxins, GAS and CKS) by the bacteria which could release in the root media and affect its growth and extension positively.

The resultant could be more absorption of nutrients which reflect more growth activity, nitrogenous compounds assimulation, forming more growth substances (GA3, IAA, IBA and KI), more cell division and enlargement, more forming of tissues and organs.

Effect of the Interaction Between Wheat Cultivars and Biofertilization: The effect of interaction between wheat cultivars and biofertilization on plant height, No. of tillers / plant, No. of leaves / plant, No. of spikes / plant, flag leaf area and dry weight of (leaves, tillers and spikes / plant) were significant.

The results in Table (3) showed that the effective treatments for all characters under study were obtained from Gemiza 9 cultivar and inoculation with Azos + yeast, while the differences between the above one and the treatment of Gemiza 9 cultivar and inoculation with yeast not reached to the significant value.

These results are confirmed with that obtained by Abd-El Razik[20] and Hosam-El Din[18], who reported that the interaction between wheat cultivars and biofertilization affected significantly in growth characters.

Yield and its Components :

Effect of Cultivars: Data in Table (4) indicated that there were significant differences between cultivars in all characters under this study i.e. plant height, No. of spikes / m^2, spike length, No. of grains / spikes, weight of grains / spike, 1000 grains weight and grain, straw and biological yield / fed except No. of spike / m^2 and harvest index.

Sakha-93 cultivar surpassed other two cultivars in spike length, No. of grains / spike, weight of grains / spike and grain yield / fed., Gemiza-7 exceeded the others in plant height, 1000 grains weight, straw yield / fed. and biological yield / fed. followed by Gemiza-9.

Table 4: Effect of cultivars and biofertilizers on yield and its components of wheat. (combined analysis of 2004/2005 and 2005/2006 seasons)

Characters / Treatments		Plant height (cm)	No. of spike/m^2	Spike length (cm)	No. of grains/spike	Weight of grains/spike (g)	1000 grains weight (g)	Grain yield (ton/fed)	Straw yield (ton/fed)	Biological yield (ton/fed)	Harvest index
Cultivars	Sakha-93	83.8	530.9	11.6	75.6	4.5	46.5	2.450	3.930	6.380	0.39
	Gemiza-7	96.4	527.3	10.5	71.4	4.4	48.6	2.340	4.577	6.917	0.34
	Gemiza-9	95.2	531.3	11.0	71.1	4.3	44.5	2.256	4.540	6.790	0.33
L.S.D. at 0.05		2.3	n.s	0.5	2.7	0.1	1.0	0.100	0.113	0.115	n.s
Biofertilizers	Control (0)	89.8	503.5	10.6	71.1	3.90	45.0	2.000	4.000	6.000	0.33
	Azo.	91.7	515.6	10.9	73.4	4.40	46.5	2.340	4.321	6.661	0.35
	Yeast	92.5	541.6	11.2	72.7	4.55	47.1	2.500	4.53	7.03	0.36
	Azo.+ yeast	93.2	558.7	11.6	73.6	4.70	47.5	2.520	4.566	7.086	0.36
L.S.D. at 0.05		2.1	25.1	0.9	2.1	0.62	1.6	0.345	0.325	0.600	n.s

Table 5: Effect of interaction between cultivars and biofertilizers on yield and its components of wheat . (combined analysis of 2004/2005 and 2005/2006 seasons)

Characters / Cultivars	Treatments / Biofertilizers	Plant height (cm)	No. of spike/m^2	Spike length (cm)	No. of grains/spike	Weight of grains/spike (g)	1000 grains weight (g)	Grain yield (ton/fed)	Straw yield (ton/fed)	Biological yield (ton/fed)	Harvest index
Sakha-93	Control	82.9	503.1	11.0	74.1	3.96	45.1	2.100	3.750	5.850	0.36
	Azo.	84.3	520.3	11.5	76.1	4.61	46.3	2.510	4.015	6.525	0.39
	Yeast	83.2	539.3	11.9	75.4	4.55	47.1	2.590	4.000	6.590	0.39
	Azo.+ yeast	84.9	561.2	11.9	76.4	4.75	47.4	2.599	4.030	6.629	0.39
Gemiza-7	Control	93.4	507.3	10.0	70.5	4.00	47.0	2.050	4.070	6.120	0.36
	Azo.	96.9	511.4	10.2	72.1	4.33	48.5	2.310	4.580	6.890	0.33
	Yeast	97.5	540.6	10.7	71.0	4.65	49.2	2.500	4.800	7.300	0.34
	Azo.+ yeast	97.9	550	11.3	71.9	4.81	49.8	2.530	4.86	7.390	0.34
Gemiza-9	Control	93.1	500.0	10.7	68.7	3.85	43.0	1.950	4.190	6.140	0.32
	Azo.	94.0	515.2	10.9	71.9	4.30	44.7	2.210	4.370	6.580	0.34
	Yeast	96.7	545.1	11.1	71.8	4.45	45.0	2.411	4.790	7.201	0.34
	Azo.+ yeast	97.1	565	11.5	72.0	4.49	45.2	2.453	4.810	7.263	0.34
L.S.D. at 0.05		3.9	37.5	0.9	3.1	0.66	0.9	0.269	0.300	0.450	n.s

It could be concluded that varietal differences between wheat cultivars may be due to genetical differences between cultivars.

Abd El-Gawad *et al*.,[15] found that wheat cultivars differed in partitioning and migration of the total available photosynthate to economic yields. Also, wheat cultivars differed in carbon equivalent for vegetative components and grain and in production value of vegetative matter, grain yield and coefficient energy of crop and harvest index.

The differences in spike length between wheat cultivars might be due to the differences in number and / or the length of internodes of the rachis, while the differences in 1000 grain weight might be attributed to variation in translocation rate of photosynthate from leaves to the storing organs i.e. the grain. The differences between cultivars in the filling period and / or the filling rate of grains might owe much to this finding.

These results were in harmony with the results obtained by El-Gambeehy *et al*.,[21], Hassanein and Gomaa[24], Zaki *et al*.,[4] and Hosam El-Din[18].

Effect of Biofertilization: With regard to the effect of biofertilization on wheat yield and its components, the results given in Table (4), generally, showed that all characters under this study except harvest index were significantly affected by inoculation of wheat grains with Azospirillum or yeast or Azo + yeast when compared with the control treatment (without inoculation).

The biotreatments of yeast + Azo realized significant increases in all characters under study except harvest index, while biotreatment of yeast had significant effect on all characters under study except spike length, No. of grains / spike and harvest index respectively in comparison with the recommended dose of NPK. In another way, the biofertilizers could replace 50 % of the chemical fertilizers recommended with increasing of yield and its components. El-Khaloy and Gomaa[13] stated that the biofertilizer could replace 50 % of the chemical fertilizer recommended for milt plants without decreasing the green and dry fodder, this could be attributed to the plant growth promoting substances produced by the biofertilizer. In addition to the reasonable quantity of atmospheric nitrogen fixed by Azo Gomaa[22]. These reaction saved more available nutrients for enzymes required to building up the different organs compounds and consequently for better growing wheat plants.

Effect of Interaction Between Wheat Cultivars and Biofertilization: The effect of interaction between wheat cultivars and biofertilizer on plant height, No. of spike / m^2, spike length, No. of grains / spike, weight of grains / spike, 1000 grains weight and straw, grain and biological yields / fed. were significant. The results reported in Table (5) showed that the effective treatments for plant height, weight of grains / spike, 1000 grains weight, straw yield and biological yield / fed. were obtained from Gemiza-7 cultivar with Azos + yeast + 50 % NPK, as well as for No. of grains / spike, spike length and grains yield / fed. was Sakha-93 with Azos + yeast + 50 % NPK.

The differences between wheat cultivars with Azos + yeast + 50 % NPK did not reach the significant level in No. of spike / m^2, spike length (cm), weight of grains / spike (g), grain yield / fed. and harvest index. These results are in harmony with those obtained by Sharief *et al*.,[23], Hassanein and Gomaa[24], Abd El-Razik[20] and Hosam El-Din[18].

In conclusion, the use of biofertilizers became ineludible to minimize the environmental pollution, caused by the chemical ones, and to improve the yield quality of various crops needed at the time being.

Although 50 % of NPK was replaced by biofertilizers, the yield and its components of wheat cultivars increased compared to that obtained with the recommended dose of NPK. Finally, the biofertilizers of efficient strains could save 50 % of the recommended dose of NPK decreasing yield of crops in newly cultivated land.

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