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Reducing pollution in newly reclaimed sandy saline soils due to wheat nitrogen fertilization by using natural and safety substances

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Key words: Wheat, Yeast extract, Humic acid, Seed treatments, Foliar spraying.

Abstract

In order to explore the possibility of enhancing wheat productivity by using natural and safety substances under newly reclaimed soils conditions, an experiment was conducted at the Experimental Station Farm in Kalabsho and Zayian, Faculty of Agriculture, Mansoura University, Egypt, during 2011/2012 and 2012/2013 seasons. A strip-split plot design with four replicates was used. The vertical plots were assigned to soaking seed treatments (untreated seed, soaking seed in water, yeast extract, humic acid and the mixture of yeast extract and humic acid). The Horizontal plots were devoted to foliar spraying with same aforementioned treatments. The sub – plots were allocated to nitrogen levels (70, 90 and 110 kg N/fed). Soaking seeds in mixture of yeast extract and humic acid produced highest values of all studied characters compared with other soaking seed treatments. Foliar spraying with mixture of yeast extract and humic acid resulted the highest values of growth, yield components, grain and straw yields as well as grains quality. Mineral fertilizing with 110 kg N/fed produced highest values of all studied characters. In general, fertilizing with 90 kg N/fed came in the second rank with little differences. It could be recommended that fertilizing wheat plants with 90 kg N/fed (saved 20 kg N/fed) and soaking seeds in mixture of yeast extract at rate of 100 ml/Liter and humic acid at rate of 5 ml Actosol/Liter in addition foliar spraying plants with the same mixture under conditions of newly reclaimed sandy saline soils (Kalabsho and Zayian region, Dakahlia, Egypt).

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Introduction

Wheat (*Triticum aestivum vulgare* L.) is one of the most important cereal crops in Egypt and all over the world. In Egypt, the total cultivated area of wheat reached about 3.2 million feddan and the total production exceeded 8.8 million tons with an average of 18.25 ardab/fed (FAO, 2013). The gap between wheat consumption and production in Egypt is continuously increased due to steady increases in the human population with limited cultivated area. Thus, using suitable agricultural practices *i.e.* seed soaking and foliar spraying with natural and safety substances as well as nitrogen levels may affect wheat productivity.

Foliar fertilization is a technique of feeding plants by applying natural and safety substances *i.e.* yeast extract and humic acid directly to their leaves, which may be vary according to environmental conditions, physiological state of development and state of nutrition. Seed soaking treatments in water or natural substances may enhance germination, growth and yield.

Plant growth and development is known to be under the control of endogenous hormones produced within the plant. Lately, a great attention has been focused on the possibility of using natural and safety substances which are rich sources of phytohormones in order to enhance plant growth and development. In this regard, yeast extract have been reported to be rich source of phytohormones (especially cytokinins), vitamins, enzymes, amino acids and minerals (Mahmoud, 2001). Castelfranco and Beale (1983) stated that yeast extract had stimulatory effects on cell division and enlargement, protein and nucleic acid synthesis and chlorophyll formation. Also, Barnett *et al.* (1990) decided the beneficial role of using yeast extract during stress due to its cytokinins content. Khedr and Farid (2000) confirmed that dry yeast extract affect growth due to its ability in induction of endogenous hormones *i.e.* GA_3 and IAA. Improving growth and productivity of wheat by application of yeast extract were recorded by Zaki, Nabila *et al.* (2007).

Humic acid (HA) is a principal component of humic substances, which are the major organic constituents of soil (humus). Humic substances have many beneficial effects on soil physical structure (Cimrin and Yilmaz, 2005) and soil microbial populations as well as increase modify mechanisms involved in plant growth stimulation, cell permeability and nutrient uptake (Pascual *et al.*, 1999) and increasing yield (Akinremi *et al.*, 2000). Recently, among the fertilization strategies, the foliar spraying with different molecules as humic acid have no harmful threat to the quality of the environment (Senn, 1991). Many researchers studied the effects of humic acid on growth and yield of wheat. In this regard; Khan and Mir (2002) emphasized significant effect of humic acids on yield and yield components of wheat. Moreover, Delfine *et al.* (2005) concluded that foliar application of humic acid had limited promoting effects on plant growth, grain yield and quality of wheat. Ali, Laila and Elbordiny (2009) showed that soaking seeds in potassium humate alone or combined with foliar spraying with potassium humate also significantly increased both grain and straw yield of wheat plants, as compared to the control. On the other hand, Khan *et al.* (2010) found that humic acid (HA) applied alone at 3 kg/ha or in combination with half rate of nitrogen fertilizer (30 kg ha^{-1}) recorded the maximum yield of wheat. HA has great potential as a low cost natural fertilizer to improve soil fertility on sustainable basis. In the same trend, Bakry *et al.* (2013) concluded that foliar spraying wheat plants with humic acid at 13 mg/L significantly increased growth, yield components and grain yield.

Nitrogen supply to the plant will influence the amount of protein, protoplasm and chlorophyll formed. In turn, this influences cell size, leaf area and photosynthetic activity. Wheat is very sensitive to deficient nitrogen and very responsive to nitrogen fertilization (David *et al.*, 2005). Nitrogen availability plays a key role in determining tiller number, grain number and grain size in wheat plants (Delfine *et al.*, 2005). Many workers all over the world concluded that using nitrogen fertilizer in suitable needed levels could improve growth, yield and its components as

well as quality of wheat *i.e.* Mekhemar (2008), Seadh *et al.* (2009), Abedi *et al.* (2010), Tababtabaei and Ranjbar (2012), Atia and Ragab (2013) and Seleem and Abd El –Dayem (2013).

This investigation aimed to evaluate the effect of soaking seed, foliar spraying treatments in reducing nitrogen fertilizer requirements and maximizing on growth, yields and its attributes and grain quality of wheat under the environmental conditions of newly reclaimed sandy saline soils in Kalabsho and Zayian, Dakahlia Governorate.

Materials and methods

Study site and objective

The field experiments were conducted at the Experimental Station Farm in Kalabsho and Zayian region, Faculty of Agriculture, Mansoura University, Dakahlia Governorate, Egypt, during 2011/2012 and 2012/2013 seasons. The objective of this study was decided the effect of soaking seed, foliar spraying treatments in reducing nitrogen fertilizer requirements and maximizing growth, yields and its attributes and grain quality of wheat Sakha 94 cultivar under the environmental conditions of newly reclaimed sandy saline soils. The Egyptian wheat cultivar (Sakha 94) was obtained from Wheat Research Section, Field Crops Research Institute, Agricultural Research Center, Giza, Egypt.

Experimental design and treatments

The experiments were carried out in a strip-split plot design with four replicates. Each experiment included seventy five treatments comprising, five soaking seed treatments, five foliar application treatments and three nitrogen fertilizer levels. The vertical plots were assigned to soaking seed treatments as following:

1- Untreated seed (control).
2- Soaking seed in tap water.
3- Soaking seed in yeast extract* at the rate of 100 ml/Liter.
4- Soaking seed in humic acid** at the rate of 5 ml Actosol/Liter.
5- Soaking seed in the mixture of yeast extract
6- at the rate of 100 ml/Liter and humic acid at
7- the rate of 5 ml Actosol/Liter.

Seeds were soaked for 12 hours in all soaking treatments and then air dried before sowing in the field.

Active dry yeast were dissolved in water at the rate of 1 g/liter followed by adding sugar at ratio 1:1 and kept overnight for activation and reproduction of yeast and multiplied efficiently during conducive aerobic. These nutritional conditions allowed to produce denovo beneficial bio-constituent, (carbohydrates, sugars, proteins, amino acids, fatty acids, hormones, etc.), then these constituents could release out of yeast cells in readily form by two cycles of freezing and thawing for disruption of yeast cells and releasing their content. This technique for yeast preparation was modified by Spencer *et al.* (1983).

Humic acid is the active ingredient of Actosol product. Actosol is an organic biostimulant activator derived from a specialized coal referred to as leonardite. Leonardite is identical to natural humus which is the building block of natural organic matter in the soil. The natural organic fertilizer Actosol contains 1-5-6 NPK and 20 % humic acid, and manufactured by Arctick Inc, Park Meadow Drive, Chantilly, VA, USA.

The Horizontal plots were devoted to five foliar spraying treatments as follows:

1- Without foliar spraying (control).
2- Foliar spraying with water.
3- Foliar spraying with yeast extract at the rate of 100 ml/Liter.
4- Foliar spraying with humic acid at the rate of 5 ml Actosol/Liter.
5- Foliar spraying with the mixture of yeast extract at the rate of 100 ml/Liter and humic acid at the rate of 5 ml Actosol/Liter.

The foliar solution volume was 200 Liter/fed and spraying was conducted by hand sprayer (for experimental plots) until saturation point twice after 40 and 55 days from sowing.

While, the sub – plots were allocated to nitrogen fertilizer levels (70, 90 and 110 kg N/fed). The nitrogen fertilizer in the form of ammonium nitrate (33.5 % N) was applied at the aforementioned rates as side – dressing in four equal doses prior every irrigation and finished before heading.

Each experimental unit area was 3 X 3.5 m occupying an area of 10.5 m^2 *i.e.* 1/400 feddan (one feddan = 4200 m^2). The soil in the summer season was uncultivated in both seasons. The soil of experimental site was characterized as a sandy saline soil as shown in Table 1, which cleared some physical and chemical properties.

Agricultural practices

The experimental field was well prepared through two ploughings, compaction and then divided into the experimental units with dimensions as previously mentioned. Calcium superphosphate (15.5 % P_2O_5) was applied during soil preparation (after ploughing and before division) at the rate of 200 kg/fed. Wheat seeds at the rate of 90 kg/fed were sown by using broadcasting Afir method on the third week of November in both seasons. Potassium sulphate (48 % K_2O) at the rate of 75 kg/fed was broadcasted in one dose before the second irrigation. The common agricultural practices for growing wheat according to the recommendations of Ministry of Agriculture were followed, except the factors under study.

Studied characters

After 120 days from sowing, one square meter was randomly choice from each sub – plot to estimate; 1) Total chlorophyll (SPAD): Chlorophyll content in flag leaf was assessed by SPAD-502 (Minolta Co. Ltd., Osaka, Japan). 2) Flag leaf area (cm^2). It was determined using Field Portable Leaf Area Meter AM-300 (Bio-Scientific, Ltd., Great Am well, Herefordshire, England). 3) Plant height (cm).

At harvesting, one square meter was randomly selected from each sub – plot to estimate; 1) Number of spikes/m^2. 2) Spike length (cm). 3) Number of grains/spike. 4) Grains weight/spike (g). 5) 1000 – grain weight (g). 6) Grain yield (ardab/fed). It was calculated by harvesting whole plants in each sub-plot and air dried, then threshed and the grains at 13 % moisture content were weighted in kg and converted to ardab per feddan (one ardab = 150 kg). 7) Straw yield (t/fed). The straw resulted from previous sample was weighted in kg/plot, and then converted to ton per feddan. 8) Crude protein percentage in grains. It was estimated by the improved Kjeldahl – method according to A.O.A.C. method (1990), modified by distilling the ammonia into saturated boric solution and titration in standard acid. Crude protein percentage was calculated by multiplying the total nitrogen values in wheat flour by 5.75. 9) Carbohydrates percentage in grains. It was estimated using the anthrone method as described by Sadasivam and Manickam (1996).

Statistical analysis

All obtained data were statistically analyzed according to the technique of analysis of variance (ANOVA) for the strip split – plot design as published by Gomez and Gomez (1984) by using MSTAT statistical package (MSTAT-C with MGRAPH version 2.10, Crop and Soil Sciences Department, Michigan State University, USA). Least Significant Difference (LSD) method was used to test the differences between treatment means at 5 % level of probability as described by Snedecor and Cochran (1980).

Results

Effect of seed soaking treatments

Seed soaking treatments caused significant effects on wheat growth and yield attributes in both seasons as shown from results presented in Tables 2 and 3. Seed soaking treatments in water, yeast extract, humic acid and the mixture of yeast extract and humic acid significantly increased wheat growth and yield attributes characters as compared with the control treatment (untreated seeds) in both growing seasons. Highest growth characters *i.e.* total chlorophyll content (53.79 and 54.95), flag leaf area (27.21 and 30.53) and plant height (90.20 and 91.55) as well as yield attributes *i.e.* number of spikes/m^2 (258.8 and 265.7), spike length, (11.45 and 11.66) number (51.30

and 53.32) and weight of grains/spike (2.98 and 3.03) and 1000-grain weight (51.56 and 52.46) were obtained from soaking wheat seeds before sowing in the mixture of yeast extract at the rate of 100 ml/Liter beside humic acid at the rate of 5 ml Actosol/Liter in the first and second seasons, respectively. Soaking seeds in yeast extract at the rate of 100 ml/Liter ranked after previously mentioned treatment concerning growth and yield attributes without significant differences between them in total chlorophyll content in the first seasons and plant height in both seasons. Soaking seed in humic acid at the rate of 5 ml Actosol/Liter ranked after yeast extract treatment followed by water treatment in both seasons.

Table 1. Some physical and chemical properties of the experimental site during 2011/2012 and 2012/2013 seasons.

	Sand	*Silt*	*Clay*	*$CaCO_3$*	*EC*	*pH*	*OM*	*Available PPM*		
Seasons	%	%	%	%	*Ds m^{-1}*	%	%	N	P	K
2011/2012	79.6	14.25	6.15	0.42	8.9	8.48	0.78	3.78	3.89	209.1
2012/2013	76.85	15.32	7.83	0.40	8.7	8.42	0.42	5.52	5.64	251.3

Table 2. Total chlorophyll, flag leaf area, plant height, number of spikes/m^2, spike length and number of grains/spike as affected by seed soaking and foliar spraying treatments under nitrogen fertilizer levels as well as their interactions during 2011/2012 and 2012/2013 seasons.

Characters	*Total chlorophyll (SPAD)*		*Flag leaf area (cm^2)*		*Plant height (cm)*		*Number of spikes/m^2*		*Spike length (cm)*		Number of grains/spike	
Treatments												
Seasons	2011/ 2012	2012/ 2013	2011/ 2012	2012/ 2013	2011/ 2012	2012/ 2013	2011/ 2012	2012/ 2013	2011/ 2012	2012/ 2013	2011/ 2012	2012/ 2013
						A- Seed soaking treatments:						
Untreated	42.82	45.20	17.85	20.69	80.0	81.3	203.1	209.3	9.01	9.15	40.0	41.2
Water	47.51	48.44	18.21	25.97	82.1	83.1	213.2	219.0	9.49	9.62	41.7	46.0
Yeast extract	53.12	53.92	25.60	29.73	89.5	90.9	227.8	234.0	11.19	11.38	49.7	50.8
Humic acid	52.64	53.27	24.81	29.28	84.8	86.2	227.4	231.6	10.64	10.84	48.8	49.8
Yeast + Humic acid	53.79	54.95	27.21	30.53	90.2	91.5	258.8	265.7	11.45	11.66	51.3	53.3
LSD at 5 %	0.96	0.83	0.34	0.41	1.6	1.7	10.1	9.1	0.25	0.26	0.9	0.7
						B- Foliar spraying treatments:						
Without	46.23	47.92	20.73	24.63	80.2	81.7	198.3	203.7	9.80	9.93	42.7	44.7
Water	48.08	49.63	21.45	25.70	82.0	83.3	210.3	215.1	9.92	10.10	45.1	46.5
Yeast extract	51.85	52.68	23.49	28.54	88.6	89.8	232.8	239.4	10.68	10.89	47.5	49.7
Humic acid	50.95	51.83	22.79	27.40	85.6	86.9	221.6	227.0	10.40	10.56	46.8	48.5
Yeast + Humic acid	52.76	53.72	25.22	29.94	90.1	91.3	267.2	274.3	10.98	11.18	49.2	51.6
LSD at 5 %	0.34	0.45	0.20	0.24	1.2	1.3	4.5	4.7	0.20	0.15	0.7	0.6
						C- Nitrogen fertilizer levels:						
70 kg N/fed	49.27	50.36	21.63	26.33	81.9	83.5	213.4	219.2	10.00	10.19	45.6	47.3
90 kg N/fed	49.88	51.14	22.75	27.22	86.2	87.4	226.4	232.4	10.42	10.60	46.4	48.1
110 kg N/fed	50.76	51.96	23.83	28.17	87.8	88.9	238.3	244.2	10.64	10.81	46.8	49.2
LSD at 5 %	0.10	0.11	0.12	0.10	0.3	0.3	1.8	1.9	0.03	0.04	0.2	0.1
						D- Interactions:						
A × B	*	*	*	*	NS	NS	*	*	NS	*	*	*
A × C	*	*	*	NS	*	NS	NS	NS	*	*	NS	*
B × C	NS	NS	NS	*	NS	NS	NS	NS	NS	NS	NS	*
A × B × C	NS	NS	*	*	NS	NS	*	*	NS	NS	*	*

There were significant differences among studied seed soaking treatments on grain and straw yields as well as grain quality (protein and carbohydrates contents) in both seasons (Table 3). Soaking seeds before sowing in the mixture of yeast extract in addition humic acid produced highest values and significantly increased grain yield by (11.48 %), straw yield by (9.98 %), protein content by (6.12 %) and carbohydrates content by (4.97 %) over both seasons compared with control treatment. However, soaking seeds in yeast extract alone came in the second rank after soaking in the mixture of yeast extract and

humic acid followed by soaking in humic acid alone then soaking in water in both seasons.

Effect of foliar spraying treatments

Relevant results presented in Tables 2 and 3 show that the effect of foliar spraying treatments on growth and yield attributes was significant in both seasons. There were substantial differences in all studied growth and yield attributes among foliar spraying treatments (spraying with water, yeast extract, humic acid and the mixture of yeast extract and humic acid) as compared with control treatment (without foliar spraying) in both seasons. Foliar spraying with the mixture of yeast extract at the rate of 100 ml/Liter and humic acid at the rate of 5 ml Actosol/Liter produced highest values of total chlorophyll content, flag leaf area, plant height, number of spikes/m^2, spike length, number and weight of grains/spike and 1000-grain weight. The corresponding data were (52.76 and 53.72), (25.22 and 29.94), (90.13 and 91.31), (267.2 and 274.3), (10.98 and 11.18), (49.29 and 51.64), (2.95 and 3.01) and (49.42 and 50.94) in the first and second seasons, respectively. On the other hand, control treatment (without foliar spraying) produced the lowest values of these characters in the two growing seasons. However, wheat plants sprayed with yeast extract alone came in the second rank after those sprayed with the mixture of yeast extract and humic acid followed by those sprayed with humic acid alone and water in both seasons.

Table 3. Grains weight/spike, 1000-grain weight, grain and straw yields, protein and carbohydrates contents in grains as affected by seed soaking and foliar spraying treatments under nitrogen fertilizer levels as well as their interactions during 2011/2012 and 2012/2013 seasons.

Characters	*Grains weight/spike (g)*		*1000-grain weight (g)*		*Grain yield (ardab/fed)*		*Straw yield (t/fed)*		*Protein (%)*		Carbohydrates (%)	
Treatments	2011/2	2012/2	2011/2	2012/2	2011/2	2012/2	2011/2	2012/2	2011/2	2012/2	2011/2	2012/2
Seasons	012	013	012	013	012	013	012	013	012	013	012	013
A- Seed soaking treatments:												
Untreated	2.23	2.33	38.90	39.62	13.24	13.32	1.568	1.566	10.20	10.22	75.72	77.00
Water	2.29	2.34	43.21	45.17	13.26	13.34	1.570	1.573	10.21	10.27	77.27	78.26
Yeast extract	2.49	2.55	49.53	50.75	14.50	14.58	1.698	1.682	10.60	10.67	79.16	79.68
Humic acid	2.39	2.44	48.56	50.05	14.20	14.25	1.669	1.675	10.47	10.52	78.66	79.66
Yeast + Humic acid	2.58	2.63	51.56	52.46	14.76	14.85	1.706	1.741	10.81	10.86	79.50	80.81
LSD at 5 %	0.03	0.05	0.40	0.37	0.17	0.16	0.055	0.047	0.03	0.06	0.27	0.47
B- Foliar spraying treatments:												
Without	2.23	2.27	42.86	44.24	13.47	13.48	1.597	1.601	10.25	10.29	76.96	78.10
Water	2.28	2.39	45.04	46.22	13.59	13.66	1.624	1.629	10.31	10.35	77.43	78.93
Yeast extract	2.50	2.55	47.64	48.75	14.30	14.40	1.664	1.664	10.57	10.65	78.61	79.41
Humic acid	2.42	2.47	46.80	47.90	14.13	14.22	1.651	1.657	10.48	10.52	78.24	79.09
Yeast + Humic acid	2.55	2.61	49.42	50.94	14.48	14.57	1.675	1.686	10.68	10.73	79.07	79.89
LSD at 5 %	0.04	0.06	0.35	0.26	0.11	0.06	0.057	0.058	0.02	0.03	0.14	0.15
C- Nitrogen fertilizer levels:												
70 kg N/fed	2.27	2.31	45.19	46.39	13.38	13.42	1.605	1.632	10.22	10.27	77.79	78.60
90 kg N/fed	2.44	2.48	46.27	47.39	14.20	14.32	1.656	1.648	10.51	10.57	78.05	79.10
110 kg N/fed	2.49	2.58	47.60	49.04	14.40	14.46	1.665	1.662	10.64	10.69	78.34	79.55
LSD at 5 %	0.01	0.02	0.15	0.13	0.05	0.04	0.025	0.025	0.01	0.02	0.06	0.06
D- Interactions:												
A × B	*	NS	*	*	NS	*	NS	NS	*	*	*	*
A × C	*	NS	*	*	NS	*	NS	NS	*	NS	NS	*
B × C	*	NS	NS	NS	NS	NS	NS	NS	*	NS	NS	NS
A × B × C	*	NS	*	*	*	*	NS	NS	*	NS	NS	NS

The effect of foliar spraying treatments on wheat yields and grain quality was significant in both seasons (Table 3). From obtained results, it could be observed that foliar spraying with the mixture of yeast extract and humic acid resulted in the highest values of grain and straw yields as well as grain quality in both growing seasons. It could be noticed that foliar spraying wheat plants with the mixture of yeast

extract and humic acid increased grain and straw yields, protein and carbohydrates contents in grains by 7.79, 5.09, 4.23 and 2.51 %, respectively as compared with the control treatment over both seasons. Foliar spraying with yeast extract alone ranked after aforementioned treatment followed by foliar spraying with humic acid alone and then water treatment in both seasons.

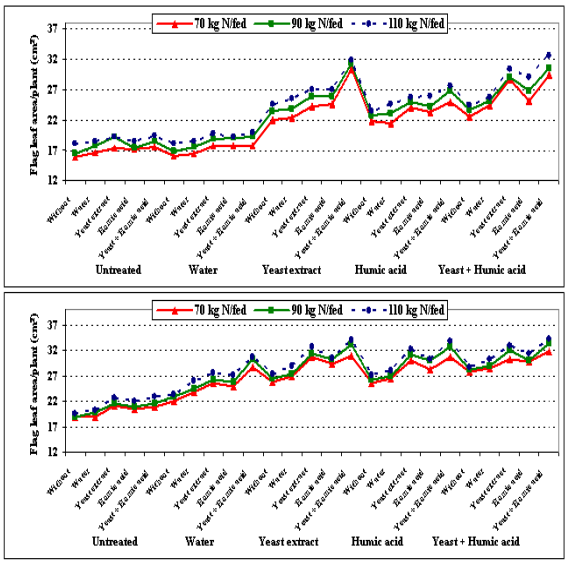

Fig. 1. Flag leaf area (cm²) as affected by the interaction among seed soaking treatments, foliar spraying treatments and nitrogen fertilizer levels during 2011 (A) and 2012/2013 (B) seasons.

Effect of nitrogen fertilizer levels

The results presented in Table 2 and 3 revealed that the effect of nitrogen fertilizer levels on growth and yield attributes was significant in the two growing seasons. It can be stated that all studied growth and yield attributes were significantly steady increased as a result of increasing nitrogen fertilizer levels from 70 to 90 and 110 kg N/fed and the differences between them were obvious in both seasons. Application the highest level of nitrogen fertilizer (110 kg N/fed) produced the highest values of total chlorophyll (50.76 and 51.96), flag leaf area (23.83 and 28.17), plant height (87.89 and 88.97), number of spikes/m² (238.3 and 244.2), spike length (10.64 and 10.81), number of grains/spike (46.87 and 49.29), grains weight/spike (2.89 and 2.98) and 1000-grain weight (47.60 and 49.04) in the first and second seasons, respectively. Fertilizing wheat plants with 90 kg N/fed came in the second rank after fertilizing with 110 kg N/fed with respect to these characters in both seasons. However, the lowest values of growth and yield attributes were produced from fertilizing wheat plants with 70 kg N/fed in the first and second seasons.

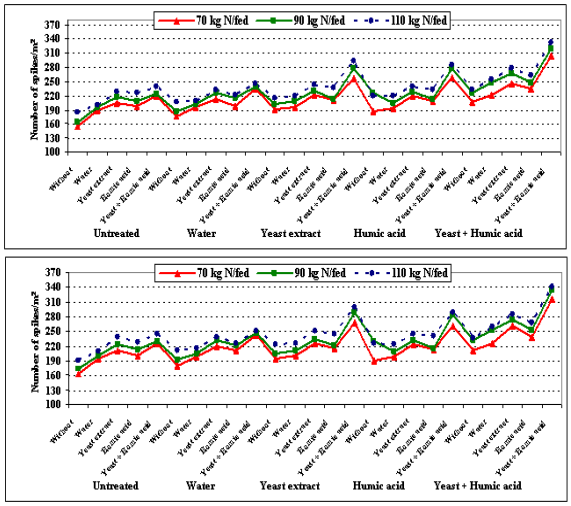

Fig. 2. Number of spikes/m² as affected by the interaction among seed soaking treatments, foliar spraying treatments and nitrogen fertilizer levels during 2011 (A) and 2012/2013 (B) seasons.

Data presented in Tables 3 indicate that the effect of nitrogen fertilizer levels on grain and straw yields as well as grain quality was significant in the two seasons. It can be stated that all studied characters of wheat plants gradually increased as a result of increasing nitrogen fertilizer levels from 70 up to 110 kg N/fed. Mineral fertilizing with 110 kg N/fed significantly exceeded other studied levels (90 and 70 kg N/fed) by (1.19 and 7.68 %), (0.69 and 2.78 %), (1.19 and 4.09) and (0.47 and 0.95) with concern grain and straw yields, protein and carbohydrates contents in grains over both seasons.

Effect of interactions

Three way interaction among seed soaking, foliar spraying treatments and nitrogen fertilizer levels showed significant effect on grains weight/spike and protein content in grains in the first season only, flag leaf area, number of spikes/m², number of grains/spike, 1000-grain weight and grain yield/fed in both seasons as presented in Tables 2 and 3. On the other hand, all interactions presented in the above mentioned Tables.

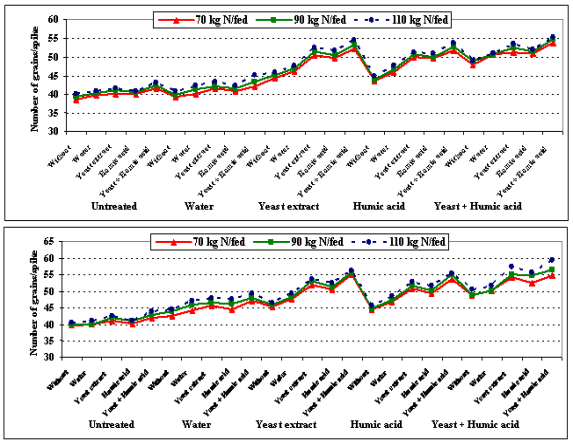

Fig. 3. Number of grains/spike as affected by the interaction among seed soaking treatments, foliar spraying treatments and nitrogen fertilizer levels during 2011 (A) and 2012/2013 (B) seasons.

Results graphically illustrated in Fig. 1 "A and B" show that the highest values of flag leaf area (cm²) were obtained when soaking wheat seeds before sowing and foliar spraying plants with the mixture of yeast extract and humic acid in addition mineral fertilizing with 110 kg N/fed in both growing seasons. Soaking wheat seeds before sowing in yeast extract and foliar spraying plants with the mixture of yeast extract and humic acid beside fertilizing with 110 kg N/fed came in the second rank without significant differences between them in both seasons. On the other hand, the lowest values of flag leaf area were resulted from untreated wheat seeds before sowing and without foliar spraying with any material under fertilizing with the lowest level of nitrogen fertilizer (70 kg N/fed) in both seasons.

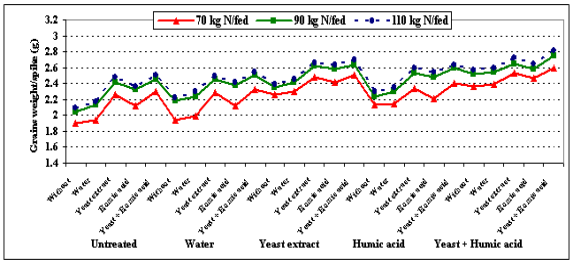

Fig. 4. Grains weight/spike (g) as affected by the interaction among seed soaking treatments, foliar spraying treatments and nitrogen fertilizer levels during 2011/2012 season.

Number of spikes/m², number of grains/spike and 1000-grain weight in both seasons as well as grains weight/spike in the first season only were significantly affected by the interaction among seed soaking treatments, foliar application treatments and nitrogen fertilizer levels. The highest values of number of spikes/m² (Fig. 2 "A and B"), number of grains/spike (Fig. 3 "A and B"), grains weight/spike (Fig. 4) and 1000-grain weight (Fig. 5 "A and B") were obtained as a result of treated seeds before sowing immediately with mixture of yeast extract and humic acid and foliar spraying plants twice with the same mixture under fertilizing with 110 kg N/fed. This treatment followed by treated seeds and foliar spraying plants with the same treatment (mixture of yeast extract and humic acid) in addition fertilizing with 90 kg N/fed. On the other hand, the lowest values of these characters were resulted from untreated seeds and without foliar spraying (control treatment) along with fertilizing with 70 kg N/fed.

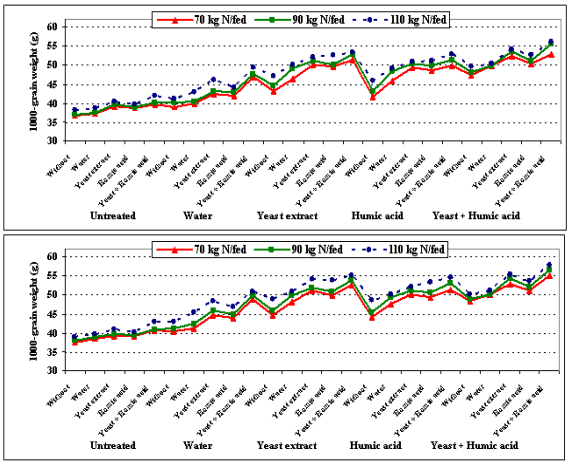

Fig. 5. 1000-grain weight (g) as affected by the interaction among seed soaking treatments, foliar spraying treatments and nitrogen fertilizer levels during 2011 (A) and 2012/2013 (B) seasons.

The interaction among three studied factors excreted significant effect on grain yield/fed in both seasons. The highest values of grain yield/fed as graphically demonstrated in Fig. 6 "A and B" were obtained from treated wheat seeds before sowing with mixture of yeast extract and humic acid and foliar spraying plants with the mixture of yeast extract and humic acid also beside mineral fertilizing plants with the highest level of nitrogen fertilizer (110 kg N/fed). This interaction treatment followed by treated seeds and foliar spraying plants with the same treatment while

using intermediate level of nitrogen fertilizer (90 kg N/fed) without significant differences between them in both seasons. Therefore, this treatment saved about 20 kg N/fed although the reduction in grain yield not exceeded 0.92 % over both seasons. Thus, it could be recommended that mineral fertilizing wheat plants with 90 kg N/fed, treated seeds and foliar spraying plants with the mixture of yeast extract and humic acid under the environmental conditions of new reclaimed sandy saline soils.

The interaction among seed soaking treatments, foliar application treatments and nitrogen fertilizer levels exhibited significant effect on protein percentage in grains in the first season. The highest value of protein % were obtained from treated seeds before sowing with mixture of yeast extract and humic acid and also foliar spraying plants with the mixture of yeast extract and humic acid in addition fertilizing plants with 110 kg N/fed as graphically illustrated in Fig. 7. On the other wise, the lowest value of protein % was produced from untreated seeds and without foliar spraying (control treatment) along with fertilizing with 70 kg N/fed.

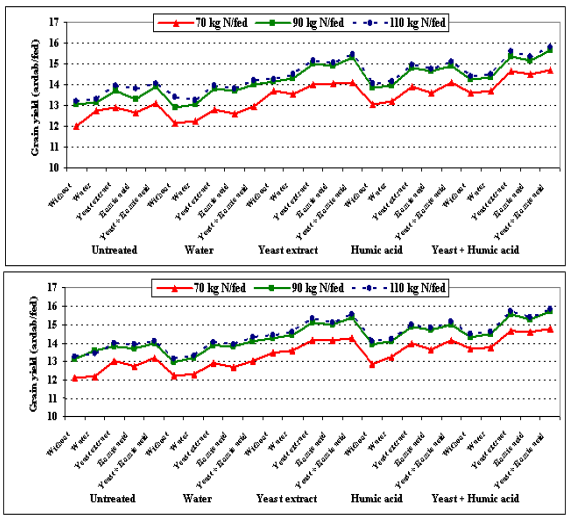

Fig. 6. Grain yield (ardab/fed) as affected by the interaction among seed soaking treatments, foliar spraying treatments and nitrogen fertilizer levels during 2012/2013 season.

Discussion

The desirable effect of soaking seeds in water may be due to more water absorption, better root development, increased size of cell walls with profound effect on transpiration and stomatal behavior (Shivamurthy, 2005).

The increases in wheat growth due to soaking seed or foliar spraying plants with yeast extract probably ascribed to its effects on cell division and enlargement, protein and nucleic acid synthesis and chlorophyll formation (Castelfranco and Beale, 1983) as well as the ability of yeast extract in induction of endogenous hormones like GA_3 and IAA (Khedr and Farid, 2000). Zaki, Nabila *et al.* (2007) stated that growth and productivity of wheat were enhanced by application of yeast extract.

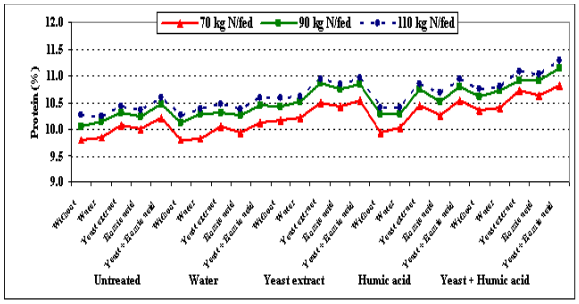

Fig. 7. Protein (%) in wheat grains as affected by the interaction among seed soaking treatments, foliar spraying treatments and nitrogen fertilizer levels during 2011/2012 season.

Soaking seeds immediately before sowing or foliar spraying plants during vegetative stage by humic acid caused increases in wheat growth, yield components, grain and straw yield as well as grain quality as shown in our results, this may be due to favourable effects of humic acid on the permeability of plant membranes, so promoting the uptake of nutrients (Pascual *et al.*, 1999). Moreover, humic acid stimulate the biochemical processes in plants such as photosynthesis and total chlorophyll content which consequently increased yield and quality (Akinremi *et al.*, 2000). Delfine *et al.* (2005), Ali, Laila and Elbordiny (2009), Khan *et al.* (2010) and Bakry *et al.* (2013) confirmed our results, whom concluded that humic acid had promoting effects on plant growth, grain yield and quality of wheat. In addition, the beneficial role of humic acid on growth and yield, humic acid have no harmful threat to the quality of the environment (Senn, 1991).

The increase in growth and yield attributes characters associated with increasing nitrogen fertilizer levels may be attributed to the role of nitrogen in improving wheat growth by enhancement meristematic activity and cell division which caused increases in internodes length and number of fertile tillers per unit area and also metabolic, photosynthesis processes and forming filled grains consequently producing heavier grains (Delfine *et al*., 2005 ; Mekhemar, 2008 and Seadh *et al*., 2009). The desirable effect of higher nitrogen fertilizer level on yields and grain quality can be easily ascribed to the nitrogen which consider as one of the major elements for plant nutrition and it increases the vegetative cover for plant and forms strong plants with long spikes. Moreover, nitrogen encourages plant to uptake other elements activating, thereby growth of plants, consequently enhancing growth measurements and all yield components. These results are in agreement with those reported by Abedi *et al.* (2010), Tababtabaei and Ranjbar (2012), Atia and Ragab (2013) and Seleem and Abd El –Dayem (2013).

Conclusion

It could be recommended that soaking seeds and then spraying plants with the mixture of yeast extract at the rate of 100 ml/Liter and humic acid at the rate of 5 ml Actosol/Liter beside mineral fertilizing with 90 kg N/fed (saving 20 kg N/fed) to increase productivity and quality of wheat as well as reducing nitrogen pollution under the environmental conditions of newly reclaimed sandy saline soils.

References

AOAC. 1990. Official Methods of Analysis. 15th Ed. Association of Official Analytical Chemists, Inc., Virginia, USA, 770-771.

Abedi T, Alemzadeh A, Kazemeini SA. 2010. Effect of organic and inorganic fertilizers on grain yield and protein banding pattern of wheat. Australian Journal of Crop Science **4(6),** 384-389.

Akinremi OO, Janzen HH, Lemke RL, Larney FJ. 2000. Response of canola, wheat and green beans to leonardite additions. Canadian Journal of Soil Science **80,** 437-443.

Ali LKM, Elbordiny MM. 2009. Response of wheat plants to potassium humate application. Journal of Applied Science Research **5(9),** 1202-1209.

Atia RH, Ragab KHE. 2013. Response of some wheat varieties to nitrogen fertilization. Journal of Soil Science and Agricultural Engineering, Mansoura University **4(3),** 309 – 319.

Bakry BA, Elewa TA, El-Kramany MF, Wali AM. 2013. Effect of humic and ascorbic acids foliar application on yield and yield components of two wheat cultivars grown under newly reclaimed sandy soil. International Journal of Agronomy and Plant Production **4(6),** 1125-1133.

Barnett JA, Payne RW, Yarrow D. 1990. Yeasts, characteristics and Identification. Cambridge University Press, London, 999.

Castelfranco PA, Beale SI. 1983. Chlorophyll biosynthesis: recent advances and area of current interest. Annual Review of Plant Physiology **34,** 241-278.

Cimrin KM, Yilmaz I. 2005. Humic acid applications to lettuce do not improve yield but do improve phosphorus availability. Acta Agricultural Scandinavica, (Section B), Soil and Plant Science **55,** 58–63.

David C, Jeuffroy MH, Meynard JM. 2005. Nitrogen management of organic winter wheat Decision-making through model-based explorations. Researching Sustainable Systems. Proceedings of the First Scientific Conference of the International Society of Organic Agriculture Research (ISOFAR), Australia (NASAA), Adelaide Convention Centre, Adelaide, South Australia, 21-23 September, 36-39.

Delfine S, Tognetti R, Desiderio E, Alvino A.

2005. Effect of foliar application of N and humic acids on growth and yield of durum wheat. Agronomy for Sustainable Development **25,** 183–191.

FAO. 2013. Food and Agriculture Organization of the United Nations, FAOSTAT, FAO Statistics Division 2014, April 2014.

Gomez KN, Gomez AA. 1984. Statistical procedures for agricultural research. John Wiley and Sons, New York, 2nd Ed., 68.

Khan AR, Mir S. 2002. Plant growth stimulation of lignite humic acid part II. Effect of lignite derived ammonium humate on wheat (*Triticum aestivum* L.) crop using different levels of phosphate fertilizer. Pakistan Journal Science of Industrial Research **45,** 273-276.

Khan R, Rashid A, Khan MS, Ozturk E. 2010. Impact of humic acid and chemical fertilizer application on growth and grain yield of rainfed wheat (*Triticum aestivum* L.). Pakistan Journal of Agricultural Research **23(3-4),** 113-121.

Khedr ZMA, Farid S. 2000. Response of naturally virus infected tomato plants to yeast extract and phosphoric acid application. Annals of Agricultural Science, Moshtohor **38(2),** 927-939.

Mahmoud TR. 2001. Botanical studies on growth and germination of Magnolia (*Magnolia grandiflora* L.) Plants. MSc Thesis, Faculty of Agriculture, Moshtohor, Zagazig University.

Mekhemar GAA. 2008. Response of wheat (*Triticum aestivum* L.) to different mineral nitrogen levels and inoculation with N2 – fixing bacteria. Journal of Agricultural Science, Mansoura University **33(1),** 447-467.

Pascual JA, Garcia C, Hernandez T. 1999. Comparison of fresh and composted organic waste in their efficacy for improvement of arid soil quality. Bioresources Technology **68,** 255-264.

Sadasivam S, Manickam A. 1996. Biochemical Methods, 2nd Ed., New Age International. India.

Seadh SE, El-Abady MI, El-Ghamry AM, Farouk S. 2009. Influence of micronutrients foliar application and nitrogen fertilization on wheat yield and quality of grain and seed. Journal of Biological Sciences **9(8),** 851-858.

Seleem SA, Abd El-Dayem SM. 2013. Response of some wheat cultivars to nitrogen fertilizer levels. Journal of Plant Production, Mansoura University **4(5),** 721 – 731.

Senn TL. 1991. Humates in Agriculture, Acres USA, Jan.

Shivamurthy D. 2005. Effects of method of planting and seed treatments on performance of wheat genotypes under rainfed conditions. MSc Thesis, in Agronomy, College of Agriculture, Dharwad University of Agricultural Sciences, Dharwad.

Snedecor GW, Cochran WG. 1980. "Statistical Methods" 7th Ed. The Iowa State Univ. Press, Iowa, USA.

Spencer TFT, Dorothy SM, Smith ARW. 1983. Yeast genetics "fundamental and applied aspects", 16-18 p, Springer. Verlag. New York, U.S.A.

Tababtabaei SA, Ranjbar GH. 2012. Effect of different levels of nitrogen and potassium on grain yield and protein of wheat. International Research Journal of Applied Basic Sciences **3(2),** 390-393.

Zaki NM, Hassanein KMS, Gamal El-Din M. 2007. Growth and yield of some wheat cultivars irrigated with saline water in newly cultivated land as affected by biofertilization. Journal of Applied Sciences Research **3(10),** 1121-1126.