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Effect of Organic and Mineral Fertilization on Wheat Yield and Quality

Amal H. EL-Guibali
Soils, Water and Environ. Res., Inst., Agric. Res. Center, Giza, Egypt

ABSTRACT

Two field experiments were carried out at El-Sharawy village in ELBostan area-Noubaria Region, Elbeheira governorate Egypt, (Latitude 30° 43' 22.01" N, Longitude 30° 16' 44.50" E), during the two growing successive seasons of 2012/2013 and 2013/2014, to study the effects of compost, nitrogen application levels and Humic substances as foliar sprays on wheat yield as well as some nutrient contents in wheat grain and straw, grain protein content and total carbohydrate of wheat plants (Masr-1 variety). A split-split plot deign with three replicates was used. The main plots were assigned for two rates of compost (0 and 10 m^3/fed), the sub-sub plots were assigned for three levels of nitrogen treatments while sub-sub plots were assigned for two K-humate treatments i.e. without addition and foliar application at 2 L fed^{-1}. The obtained results revealed that application of compost significantly increased the wheat grain and straw yields and their contents of N, P, K and grain protein. Raising mineral nitrogen fertilizer level from 50 to 75 and 100 % resulted in significant increases in 1000-grain weight, grain and straw yields/fed and protein content of grain and straw as well as N, P and K content in grain and straw. Foliar application of K-humate generally had enhancing effects on wheat productivity and improved its nutrient contents. In this concern, the soil application of 10 m^3 compost together with mineral nitrogen fertilizer at of the recommended N 75 or100 % level and 2 L fed^{-1} K-humate had the superior impact.

Keywords: Compost, K-humate, ,Grain, Straw, Yield, Protein content and Total carbohydrate, Wheat.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the major and most important crop in many countries, and it is the main winter cereal crop in Egypt. There are many attempts to increase wheat productivity in order to face the gap between consumption and production. As a result, wheat cultivated area reached, in year 2008, about 1.2 million hectare, produced only about 7.9 million ton (FAO, 2008). Such production does not meet the actual consumption and the rapid increase in the population demands. Among the various determining factors, soil fertility status is of prime importance. Hence, under the prevailing condition, restoration and maintenance of soil fertility is a basic and critical problem. This can be accomplished by adding organic materials and humic substances. Compost has a high nutritional value, with high concentrations of N, P and K and very low concentrations of heavy metals and other toxic substances (Youssf, 2011and EL-Sayed, 2012). It also improves soil physical characteristics (soil structure, aggregate stability, soil infiltration rate as well as water holding capacity) and soil chemical properties particularly decreasing its pH value and thus increasing the availability of soil nutrients for the plants (Sarwar, 2005 and Sarwar *et al.*, 2007). As a result of all previous processes, various yield components were positively affected and reflected on both grain and straw yields (Sarwar, 2005). Organic manure also increased the wheat productivity by 105 to 128 %, relative to the control (Youssef, 2011; EL-Sayed, 2012 and Youssef *et al.*, 2013). Supplying crop plants with nitrogen fertilizer plays an essential role in improving its productivity, because nitrogen is considered as one of the limiting factors to achieve the high yield of wheat crop. Humic substances as foliar sprays can also promote greater root and shoot growth, root branching, leaf chlorophyll content as well as rates of nutrient uptake, photosynthesis and respiration. Therefore, the main targets of the current investigation are increasing the grain and straw yields of wheat and improving quality through the addition of compost, nitrogen fertilizer and K-humate in combination.

MATERIALS AND METHODS

Two field experiments were carried out at El-Sharawy village in ELBostan area-Noubaria Region, Elbeheira governorate Egypt, during the two growing successive seasons of 2012/2013 and 2013/2014, to study the impact of organic, inorganic N- fertilization and Humic substances as foliar sprays on yield as well as chemical constituents of wheat plants (Masr-1 variety).Randomized soil surface (0-30 cm) samples were taken from the experimental site before sowing, as well as compost samples to determine the physical and chemical properties according to Page *et al.*, (1982)as shown in Tables (1 & 2). Compost was added and mixed thoroughly with soil surface two weeks before seeding.

Table 1. physical and chemical properties of the soils under investigation (average of two seasons).

Particle size distribution								
Coarse Sand %	Fine Sand %	Silt %	Clay %	Texture class	OM %	CaCO3 %	PH	ECe (dS m^{-1})
52.2	39.3	5.4	3.1	sand	0.16	3.5	8.1	4.1

Cations and anions in the soil paste extract, (meq /L)								available nutrients (mg kg^{-1})		
Cations				Anions						
Ca^{+2}	Mg^{+2}	Na^{+}	K^{+}	CO_3^{-2}	HCO_3^{-}	Cl^{-}	SO_4^{-2}	N	P	K
16.1	12.8	10.2	1.8	-	15.3	19.2	6.4	15	6.5	85

Table 2. Chemical composition of the tested compost:

Properties	O.M. %	Total N %	Organic Carbon (%)	C/N	pH (1:10)	EC (1:10)dS/m	Total P%	Total K %
Value	37.56	1.37	21.79	15.9:1	6.51	4.58	0.24	0.61

The treatments were as follows:

Organic fertilizer:

1. No compost
2. 10 m^3 compost/fed. added before planting

Nitrogen fertilizer:

1. 50% of the recommended rate (50 kg N/fed), N1
2. 75% of the recommended rate (75 kg N/fed), N2
3. 100% of the recommended rate (100 kg N/fed), N3

K-humate

1. without the addition of K-humate
2. Foliar spraying at the rate of 2 L fed^{-1} K-humate

The experimental design was a split-split plot with three replications. Compost treatments were arranged in the main plots, the three levels of nitrogen treatments were arranged in the sub plots, while the two K- humate treatments in a liquid form (10% K_2O) were assigned to sub-sub plots. Plot size was 10.5 m^2 in both growing seasons. Foliar spraying with 2 L K-humate fed^{-1}. Using spraying solution volume 200 L water fed^{-1} was done twice on wheat plants, before tillering and heading stages .Wheat cultivar (Masr-1 variety) was kindly obtained from Wheat Dept. Field Crops Res. Institute, Agric. Res. Center, Giza, Egypt. Super phosphate was added as a single dose at the rate of 15 kg P_2O_5 fed^{-1} and mixed in the same times with such surface layer. The nitrogen fertilizer(as ammonium sulphate 20.6% N) was added according to the treatment in two equal portions, i.e. after 30 and 60 days from sowing. Also, potassium fertilizer (as Potassium sulphate, 48% K_2O) was added at a rate of 50 kg K_2O fed^{-1}., which was divided into two equal portions applied with N fertilizer.

At harvesting, a sample of 20 plants from each plot was randomly chosen to calculate 1000 grain weight, grain, straw and biological yields were recorded on plot basis, then, they were estimated as ton fed^{-1}. Grain and straw samples were taken for chemical analysis to determine N, P and K percentages in grains and straw and their uptakes were calculated. Nitrogen content in grains and straw was determined by Keldahl method as described by A.O.A.C (1985). Protein content in the grins was calculated by multiplying N% by 5.75. Phosphorus was determined calorimetrically according to Chapman and Pratt, (1978). Potassium was determined by flam photometer according to Chapman and Pratt, (1978). Total carbohydrate was determined according to Smith et al., (1956).The data was subjected to statistical analysis and the difference between the means of treatments was tested using least significant difference test (L.S.D) at 5%. The combined analysis was carried out for the two growing seasons Snedecor and Cochran, (1967) and their average data were presented in the tables.

RESULTS AND DISCUSSION

I-Grain, straw, and biological yields

A-Effect of compost application

Data obtained in Table (3) and figure (1) revealed that the application of compost caused significant increases for grain, straw, and biological yields. In this concern, the relative increases compared to the control treatment (non composted) were 7.5, 13.52 and 11.03% for grain, straw and biological yields, respectively. These increases may be due to that soil application of compost increases the soil organic matter percentage that has been regarded a key factor determining soil fertility and productivity (Sarwar et al., 2007). Sarwar, (2005) showed that addition of compost improves the physical properties of the soil and decreases its pH value. As a result, the availability of soil nutrients for plants increased and various yield components were positively affected and ultimately these components contributed towards increasing of grain and straw yields.

B-Effect of nitrogen fertilization

Grain, straw and biological yields/fed. were significantly increased with increasing nitrogen fertilizer up to the lightest level (100 kg N/fed). This increase might be attributed to the fact that nitrogen fertilization promotes tillering in cereals and encourage the formation of more spikes/plant (El-Sebasy and Abd El-Maaboud 2003). As nitrogen is one of the most important components of cytoplasm, nucleic acid and chlorophyll, so nitrogen has an important role in encouraging cell elongation, cell division and consequently increasing vegetative growth and activation of photosynthesis process which enhance the amount of metabolites necessary for building plant organs which reflect increases in grain and straw yields. These results are in accordance with those obtained by Abbas *et al*., (2007).

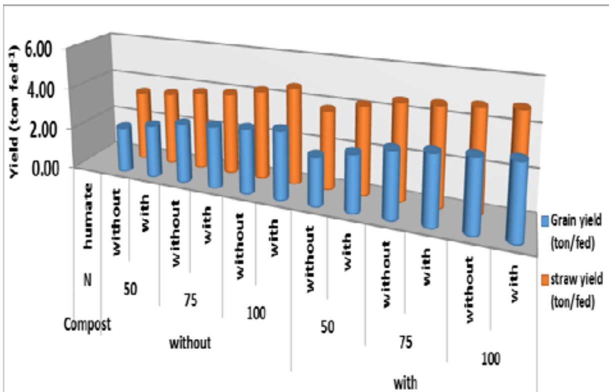

Fig.(1) Effect of Organic and Inorganic Fertilizers on grain and straw yield ton/fed

C-Effect of potassium humate

Also, data in Table (3) showed that foliar application of potassium humate increased significantly grain, straw and biological yields/fed. Humic substances can directly or indirectly affect the physiological processes of plant growth by promoting the uptake of macro-and micronutrients and affecting the biochemical substances, carrying nutrients and growth regulators, increasing the microorganism's population and acting as hormone like substances (Verlinden *et al*., 2009). Humic substances also enhanced the water retention, the ability rate of leaves for photosynthesis process, the seed filling intensity, the drought resistance of plants and acts a chelating agent through active groups for micro and macronutrients and forming organometallic complexes which are considered as a storehouse and more mobile or available to be taken up by plant and in turn reflected positively on development yield of seed and straw and their attributes (Rafla, 2012).

D- Effect of interactions:

Data in Table (3) showed that the interaction effect between compost and nitrogen fertilization treatments were found to be significant for grain, straw and biological yields/fed. The highest values were obtained when nitrogen was applied at rate of 100Kg N/fed., with 10m^3 compost/fed. On the other hand, the lowest values were obtained by application of nitrogen at rate of 50 kg N/fed without compost application. Similar results were obtained by Soliman (2007) who found that the application of N and organic manure increased plant growth and consequently the yield. These stimulatory effects of organic manure may be due to the effect of micronutrients and growth regulators present in organic manure which may have activated the cell division as well as meristematic activity in the kernel. On contrary, all aforementioned traits were not significantly affected by the interaction between compost and K-humate as shown in Table (3).

Data in Table (3) show that the interaction effect between mineral N-levels and K-humate on yield was significant and in general, plants received 100 kg N fed^{-1} and foliar application of potassium humate gave the highest significant values of grain, straw and biological yields/fed.

Concerning the interaction among compost, N-levels and K-humate on grain, straw and biological yields/fed., data in Table (3) revealed that there were positive significant effects on straw and biological yields/fed except for grain yields fed^{-1}. However, the composted fertilized with 100 kg N fed^{-1} and foliar sprayed with 2 L K-humate fed^{-1} gave the highest values of wheat yields.

Table 3. Effect of organic and inorganic fertilization on grain, straw and biological yields (ton/fed.) (combined analysis 2012/2013 and 2013/2014 seasons)

treatments		Grain Yield (ton fed^{-1})			Straw Yield (ton fed^{-1})			Biological Yield (ton fed^{-1})		
Compost (m^3 fed^{-1}) (A)	N-levels (kg/fed) (B)	Without K-humate	With K-humate	mean	Without K-humate	With K-humate	mean	Without K-humate	With K-humate	mean
0	50	2.19	2.51	2.35	3.42	3.54	3.48	5.61	6.05	5.83
	75	2.82	2.94	2.88	3.79	3.91	3.85	6.61	6.85	6.73
	100	3.05	3.22	3.14	4.25	4.60	4.43	7.3	7.82	7.57
	mean	2.69	2.89	2.79	3.82	4.02	3.92	6.51	6.91	6.71
10 m3/fed.	50	2.28	2.66	2.47	3.75	4.17	3.96	6.03	6.83	6.43
	75	3.07	3.23	3.15	4.54	4.61	4.58	7.61	7.84	7.73
	100	3.32	3.41	3.37	4.75	4.87	4.81	8.07	8.28	8.18
	mean	2.89	3.1	3.00	4.35	4.55	4.45	7.24	7.65	7.45
Average N levels	50	2.24	2.59	2.42	3.59	3.89	3.74	5.83	6.48	6.16
	75	2.95	3.09	3.02	4.17	4.26	4.22	7.12	7.35	7.24
	100	3.19	3.32	3.25	4.50	4.74	4.62	7.69	8.055	7.87
	mean	2.79	3.00	2.90	4.09	4.30	4.20	6.88	7.3	7.1
L.S.D at 5%	Compost(A)		0.06			0.08			0.13	
	N-level(B)		0.04			0.05			0.07	
	Humate(C)		0.04			0.05			0.06	
	A x B		0.19			1.26			0,51	
	A x C		n.s.			n.s.			n.s.	
	B x C		0.27			0.19			0.42	
	A x B x C		n.s.			0.11			0.51	

II- Nitrogen, phosphorus and potassium contents (kg fed^{-1})

A-Effect of compost application

Data in Tables (4,5 and 6) and figures (2,3 and 4) cleared that the application of 10 m^3 compost/fed significantly increased N, P and K contents in the grains and straw of wheat plants. In comparison with the control treatment, the relative increases in N- content in both grain and straw were 18.69 & 40.73%. The corresponding increments in P were 20.97 & 37.94% while those of K were 47.50 & 23.61 %, respectively. This may be due to mineralization of compost and slow release of minerals in available forms due to effects of several organic acids produced during compost decomposition (Sofidkoohi *et al.*, 2012). Compost application decreases N-losses caused by volatilization, leaching and denitrification by binding to nutrients and releasing with the passage of time (Sofidkoohi *et al.*, 2012). Compost also increases both soil microbial biomass and soil enzymatic activities which release P and other nutrients from the organic materials.

B- Effect of nitrogen fertilization:

The results illustrated in Tables (4, 5 and 6) showed that increasing the applied rate of nitrogen fertilizer gradually increased the content of N, P and K in both grains and straw of wheat plant at maturity stage. The highest values of content for NPK uptake were recorded by the application of 100 kg N/fed. This might be attributed to the role of nitrogen nutrient in building metabolites which increases the dry matter content and subsequently increase nutrient uptake in wheat plant. These findings are in harmony with those obtained by Abd El-Hady *et al., (*2006).

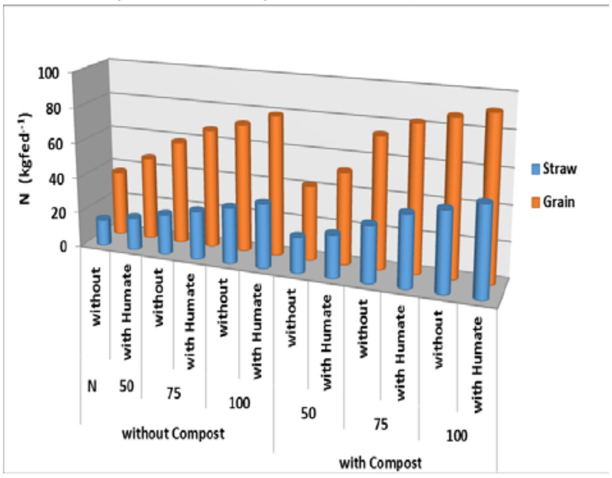

Fig. 2. Effect of Organic and Inorganic Fertilizers on N-nutrient content kg/fed.

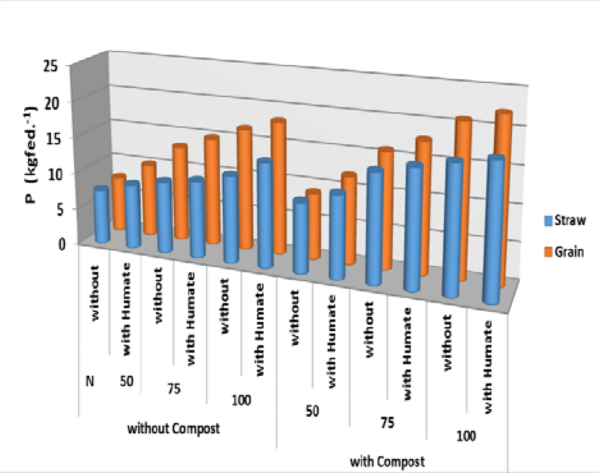

Fig. 3. Effect of Organic and Inorganic Fertilizers on P-nutrient content kg/fed

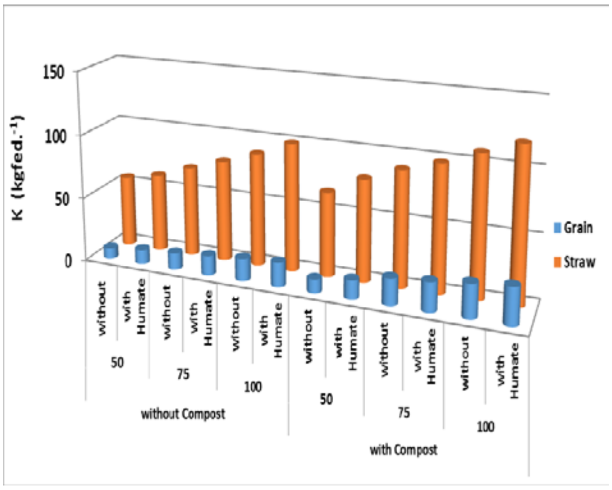

Fig. 4. Effect of Organic and Inorganic Fertilizers on K-nutrient content kg/fed

Table 4. Effect of organic and inorganic fertilization on N- content (kg fed-1) in grain and straw yield (combined analysis 2012/2013 and 2013/2014 seasons)

treatments		N- content (kg fed^{-1})								
		Grain			Straw			Total		
Compost (m^3 fed^{-1}) (A)	N-levels (kg/fed) (B)	Without K-humate	With K-humate	mean	Without K-humate	With K-humate	mean	Without K-humate	With K-humate	mean
0	50	36.91	47.10	42.01	14.81	18.27	16.54	51.72	65.37	58.55
	75	58.53	67.34	62.94	22.72	27.13	24.93	81.25	94.47	87.87
	100	72.38	79.09	75.74	31.45	36.16	33.81	103.83	115.25	109.55
	mean	55.94	64.51	60.23	22.99	27.19	25.09	78.93	91.70	85.32
10 m3/fed.	50	41.88	51.93	46.91	20.11	24.17	22.14	61.99	76.10	69.05
	75	73.99	82.30	78.15	31.76	40.29	36.03	105.75	122.59	114.18
	100	87.37	91.46	89.42	45.00	50.52	47.76	132.37	141.98	137.18
	mean	67.75	75.23	71.49	32.29	38.33	35.31	100.04	113.56	106.80
Average N levels	50	39.40	49.52	44.46	17.46	21.22	19.34	56.86	70.74	63.80
	75	66.26	74.82	70.54	27.24	33.71	30.48	93.5	108.53	101.02
	100	79.88	85.28	82.58	38.23	43.34	40.79	118.11	128.62	123.37
	mean	61.85	69.87	65.86	27.64	32.76	30.20	89.49	102.63	96.06
L.S.D at 5%	compost(A)		1.42			2.50			2.52	
	N-level(B)		1.59			0.92			1.63	
	Humate(C)		1.14			1.00			1.49	
	A x B		12.83			9.76			21.95	
	A x C		n.s.			n.s.			n.s.	
	B x C		5.21			n.s.			5.13	
	A x B x C		n.s.			n.s.			n.s.	

C-Effect of potassium humate

Also, data in Tables (4,5and 6) showed that foliar application of potassium humate increased significantly the content of N, P and K in both grains and straw of wheat plant. The stimulatory effect of humic substances have been directly correlated with enhance uptake of macronutrients such as nitrogen, phosphorus, potassium and sulfur (Caccco *et al.*, 2000) and (Delfine *et al.*, 2005). Humic substances enhance the uptake of nutrients through the stimulation of microbial activity (Mayhew, 2004). More specifically humic acids likely increased P availability and uptake by inhibiting calcium phosphate precipitation rates, forming phosphohumates that are competing for adsorption sites or it decreases the number of adsorption sites by promoting dissolution of metal solid phases via chelation. Metal micronutrient availability and uptake in the soil system have also been found to be increased in the presence of humic acids and this could be the result of increased chelation (Jones *et al.*, 2007).

D- Effect of interactions:

Data in Tables (4,5and 6) clearly showed that all aforementioned traits were significantly affected by the interaction between compost and N levels, while they were not significantly affected by the interaction between compost and K-humate.

Data also revealed that there were no significant effects on N, P and K uptake in both grains and straw due to the interaction between N -levels and K-humate except N content in grains and total N uptake by wheat plant which were significantly affected.

Moreover, data in Tables (4, 5 and 6) clearly showed that all the aforementioned traits were not significantly affected by the interaction among the three tested factors except K uptake in straw and whole plants which were significantly affected, since the composted plots at 10 m^3 fed^{-1} and received 100 kg N fed^{-1} with foliar sprayed with 2 L K-humate fed^{-1} gave the highest values.

Table 5. Effect of organic and inorganic fertilization on P- content (kg fed^{-1}) in grain and straw yield (combined analysis 2012/2013 and 2013/2014 seasons)

treatments		P- content (kg fed^{-1})								
		Grain			Straw			Total		
Compost (m^3 fed^{-1})(A)	N-levels (kg/fed)(B)	Without K-humate	With K-humate	mean	Without K-humate	With K-humate	mean	Without K-humate	With K-humate	mean
0	50	7.67	10.06	8.87	7.52	8.84	8.18	15.19	18.9	17.05
	75	13.17	14.90	14.04	9.85	10.57	10.21	23.02	25.47	24.25
	100	16.70	18.22	17.46	11.90	14.25	13.08	28.6	32.47	30.54
	mean	12.51	14.39	13.45	9.76	11.22	10.49	22.27	25.61	23.94
10 m3/fed.	50	9.03	11.96	10.50	9.62	11.25	10.44	18.65	23.21	20.94
	75	15.86	17.77	16.82	14.82	15.99	15.41	30.68	33.76	32.23
	100	20.82	22.18	21.50	17.11	18.03	17.57	37.93	40.21	39.07
	mean	15.24	17.30	16.27	13.85	15.09	14.47	29.09	32.39	30.74
Average N levels	50	8.35	11.01	9.68	8.57	10.05	9.31	16.92	21.06	18.99
	75	14.52	16.34	15.43	12.34	13.28	12.81	26.86	29.62	28.24
	100	18.76	20.20	19.48	14.51	16.14	15.33	33.27	36.34	34.81
	mean	13.88	15.85	14.87	11.80	13.16	12.48	25.68	29.01	27.35
L.S.D at 5%	OM(A)		1.11			0.87			1.13	
	N(B		0.67			0.41			0.77	
	Humate(C)		0.42			0.43			0.42	
	A x B		2.78			3.55			5.86	
	A x C		n.s.			n.s.			n.s.	
	B x C		n.s.			n.s.			1.85	
	A x B x C		n.s.			n.s			1.71	

Table 6. Effect of organic and inorganic fertilization on K- content (kg fed-1) in grain and straw yield (combined analysis 2012/2013 and 2013/2014 seasons)

treatments		K- content (kg fed^{-1})								
		Grain			Straw			Total		
Compost (m^3 fed^{-1}) (A)	N-levels (kg/fed) (B)	Without K-humate	With K-humate	mean	Without K-humate	With K-humate	mean	Without K-humate	With K-humate	mean
0	50	8.33	11.23	9.78	55.92	61.18	58.55	64.25	72.41	68.33
	75	12.99	15.19	14.09	70.43	79.18	74.81	83.42	94.37	88.90
	100	17.41	18.86	18.14	88.40	99.75	94.08	105.81	118.61	112.21
	mean	12.91	15.09	14.00	71.58	80.04	75.81	84.49	95.13	89.81
10 m3/fed.	50	10.62	14.71	12.67	65.57	79.58	72.58	76.19	94.29	85.24
	75	20.57	22.73	21.65	90.13	98.42	94.28	110.70	121.15	115.93
	100	26.35	28.89	27.62	109.33	119.23	114.28	135.68	148.12	141.90
	mean	19.18	22.11	20.65	88.34	99.08	93.71	107.52	121.19	114.36
Average N levels	50	9.48	12.97	11.22	60.75	70.38	65.56	70.22	83.35	76.79
	75	16.78	18.96	17.87	80.28	88.80	84.54	97.06	107.76	102.41
	100	21.88	23.88	22.88	98.87	109.49	104.18	120.75	133.37	127.06
	mean	16.05	18.60	17.32	79.96	89.56	84.76	96.01	108.16	102.08
L.S.D at 5%	Compost(A)		1.52			2.30			3.19	
	N-level (B)		0.37			1.22			1.32	
	Humate(C)		0.58			1.33			1.45	
	A x B		7.83			7.81			15.58	
	A x C		n.s.			n.s.			4.71	
	B x C		n.s.			n.s.			n.s.	
	A x B x C		n.s.			8.66			9.22	

III - 1000-grain weight, Protein and carbohydrate contents in grains:

A-Effect of compost application

Data obtained in Table (7) and figures(5,6 and 7) revealed that the application of compost caused significant increases for 1000 grain weight as well as protein and carbohydrate contents in grains. The promoting impact of compost on grain quality is mainly attributed to the good supply and positive effect of N-uptake by wheat which encourages greater uptake of the other available macronutrients. These results are in harmony with those reported by Youssef (2011) and EL-Sayed (2012

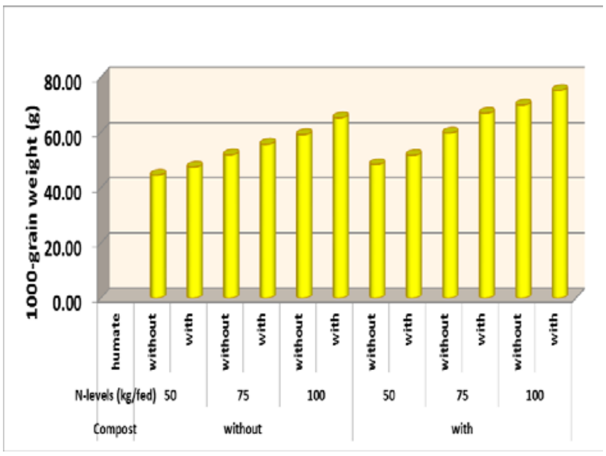

Fig. 5. Effect of Organic and Inorganic Fertilizers on 1000-grain weight (g)

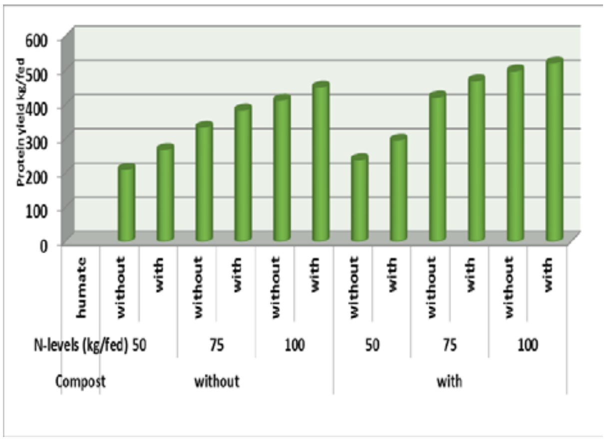

Fig. 6. Effect of Organic and Inorganic Fertilizers on protein yield kg/fed

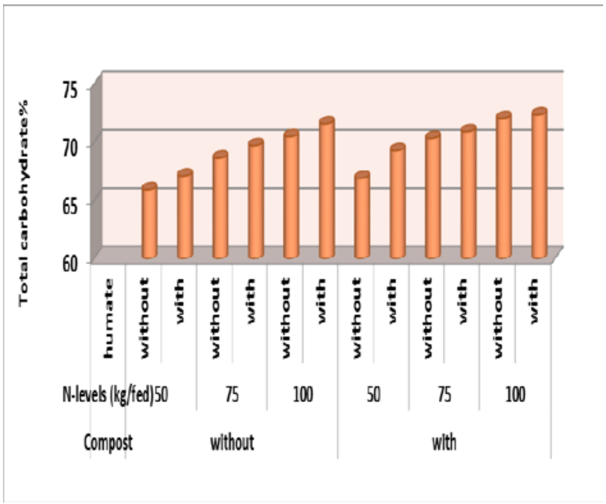

Fig. 7. Effect of Organic and Inorganic Fertilizers on total carbohydrate%

B- Effect of nitrogen fertilization

The data reported in Table (7) show that protein yield/fed. and 1000 grain weight were significantly increased by increasing N fertilization levels up to 100 kg N/fed. The beneficial effect of nitrogen fertilization on protein yield and 1000 grain weight may be due to, its favorable effect on grain yield (table 3) and /or to enhancing the absorption efficiency of the roots. Besides, the stimulating effect of nitrogen may be due to its function in plant metabolism as it considered a major constituent of amino acid, protein, nucleic acids and phospholipids. In this concern, Magda *et al.*, (2010) showed that N-fertilization of wheat plants increased the protein content and subsequently improved the grain quality. With regard to carbohydrates, data in Table (7) demonstrate that significant increase took place in total carbohydrates with increasing chemical N levels up to the highest level with no significant difference between 75 and100 Kg N rates. This increase in total carbohydrates may be due to the increase in vegetative growth, since nitrogen is an important constituent of chlorophyll which increases photosynthesis, resulting in assimilation of more carbohydrates.

C-Effect of potassium humate

Data attained in Table (7) represent the values of 1000 grain weight as well as protein and carbohydrate contents in grains as affected by K-humate application. It is clear that foliar application of K-humate augmented significantly1000 grain weight and protein contents over control by about 8.66 and 12.97 % respectively. K-humate acts like auxins and gibberellins exhibiting high amounts of phenolic and carboxyl groups as a result, metabolic processes become better, raise the efficiency of plants to water uptake, increases the ability rate of leaves for photosynthesis process and seed filling intensity. Hence, it causes a faster development and the plants reach reproductive stage earlier than the control.

Table 7. Effect of organic and inorganic fertilization on grain quality (combined analysis 2012/2013 and 2013/2014 seasons)

treatments		1000-grain weight (g)			Grain protein content (kg fed^{-1})			Total carbohydrate (%)		
Compost (m^3 fed^{-1}) (A)	N-levels (kg/fed) (B)	Without K-humate	With K-humate	mean	Without K-humate	With K-humate	mean	Without K-humate	With K-humate	mean
0	50	44.43	47.33	45.88	210.37	268.44	239.41	65.93	67.10	66.52
	75	51.88	55.67	53.78	333.62	383.82	358.72	68.63	69.70	69.17
	100	59.11	65.25	62.18	412.56	450.81	431.69	70.47	71.57	71.02
	mean	51.81	56.08	53.95	318.85	367.69	343.27	68.34	69.46	68.90
10 m3/fed.	50	48.32	51.70	50.01	238.71	296.00	267.36	66.90	69.27	68.09
	75	59.63	66.90	63.27	421.73	469.08	445.41	70.33	70.90	70.62
	100	69.83	75.17	72.50	498.00	521.29	509.65	72.03	72.33	72.18
	mean	59.26	64.59	61.93	386.15	428.79	407.47	69.75	70.83	70.29
Average N levels	50	46.38	49.52	47.95	224.54	282.22	253.38	66.42	68.19	67.30
	75	55.76	61.29	58.52	377.68	426.45	402.06	69.48	70.30	69.89
	100	64.47	70.21	67.34	455.28	486.05	470.67	71.25	71.95	71.60
	mean	55.53	60.34	57.94	352.50	398.24	375.37	69.05	70.15	69.60
L.S.D at 5%	Compost(A)		2.95			8.08			0.34	
	N-level(B)		2.13			9.06			0.36	
	Humate(C)		1.32			6.47			0.23	
	A x B		7.75			73.13			n.s.	
	A x C		n.s.			n.s.			n.s.	
	B x C		n.s.			29.90			1.27	
	A x B x C		n.s.			n.s.			1.66	

D- Effect of interactions:

Data in Tables (7) showed clearly that all the aforementioned traits *i.e.*1000 grain weight grain protein yield and total carbohydrate % were significantly affected by the interaction between compost and N levels and the interaction between N-levels and K-humate except 1000-grain weight which was not significantly affected by the second interaction. On the other hands all the aforementioned traits were not significantly affected by the interaction between compost and K-humate as shown in Table (7).

It is also clear that all aforementioned traits were not significantly affected by the interaction among the three tested factors except total carbohydrate (%) which was significantly affected and foliar sprayed plots with K-humate and received 100 kg N fed^{-1} and 10 m^3 compost fed^{-1} recorded the highest carbohydrate percentage (72.33%).

CONCLUSION

From the obtained data it could be concluded that foliar application of potassium humate 2 L fed^{-1} combined with the application of organic manure at a rate of 10 m^3 compost/fed and mineral N at a rate of 75 or 100 kg N/fed. was sufficient to produce the good quantity and quality of wheat crop.

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تأثير التسميد العضوى والمعدنى على محصول القمح وجودته

أمال حسن الجبالى
معهد بحوث الاراضى والمياه والبيئة – مركز البحوث الزراعية

أجريت تجربتان حقليتان بقرية الشعراوى بمنطقة البستان –النوبارية-محافظة البحيرة- مصر خلال الموسمين الشتويين ٢٠١٣/٢٠١٢ ، ٢٠١٤/٢٠١٣ لدراسة تأثيرالتسميد العضوى (صفر، ١٠م٣ /فدان) والنتروجين المعدنى(٥٠، ٧٥، ١٠٠ كجم نيتروجين للفدان) والرش الورقى بمحلول هيومات البوتاسيوم (بتركيز ١٠% K_2O) بمعدل ٢ لتر/فدان وايضا التفاعل بينها على إنتاج محصول القمح ومكوناته وأيضا الكمية الممتصة من النيتروجين والفوسفور والبوتاسيوم بواسطة الحبوب والقش وكذلك محتوى الحبوب من البروتين والكربوهيدرات الكلية. كانت النتائج المتحصل عليها كالاتى: - هناك زيادة معنوية فى محصولى الحبوب والقش لنبات القمح وكذلك المحتوى العنصرى لكل منها ومحتوى الحبوب من البروتين والكربوهيدرات الكلية بإضافة السماد العضوى. -أدت زيادة التسميد الأزوتى من ٥٠ الى ٧٥ و ١٠٠كجم ن/فدان إلى زيادة معنوية فى وزن الألف حبة- محصولى الحبوب والقش/فدان – نسبة البروتين فى الحبوب وكذلك الكمية الممتصة من كل من النيتروجين والفوسفور والبوتاسيوم بواسطة الحبوب والقش. - إضافة هيومات البوتاسيوم رشا على النبات بمعدل ٢لتر/فدان أدت إلى زيادة معنوية فى وزن ال١٠٠٠حبة ومحصولى الحبوب والقش ومحتوى الحبوب من البروتين والعناصر الغذائية فى الحبوب والقش وذلك مقارنة بعدم الرش.