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ASSESSMENT OF COMPOST, K-HUMATE, FULVIC ACID AND THEIR COMBINATION APPLICATION ON SOME SOIL CHEMICAL PROPERTIES, YIELD AND NUTRIENT CONTENT OF WHEAT

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ABSTRACT: *A field experiment was conducted in the Experimental Farm of Sakha Agriculture Research Station for two successive winter seasons (2010- 2011) and(2011-2012) using wheat plant (Triticum aestivum L., var Sakha 93) to study the effect of compost with two rates either 4 or 8 ton fed $^{-1}$ and 20 L fed $^{-1}$ from both potassium humate and fulvic acid on some chemical properties of soil, yield and yield component of wheat plant . The treatments were 1) soil treated with 100% NPK of recommended doses as control 2, 3) soil treated with potassium humate (K – H) and fulvic acid (F A) respectively 4, 5) soil treated with compost at the rate either 4 or 8 ton fed^{-1} 6, 7) soil treated with mixture of K –H and either C 4 or C 8 respectively 8, 9) soil treated with mixture of (F A) and either C 4 or C 8 respectively .*

The results indicated that, 1) applied conditioners positively affect chemical properties of the soil where values of EC (dS m^{-1}), pH along with $CaCO_3$ content were decreased, with OM content being increased compare to the control treatment (100% NPK) 2) the different treatments under study had highly significant effect on grain and straw yields of wheat plant, while the weight of 1O00 grains was significant.

Compost application at the rate 4 ton fed $^{-1}$ gave the highest grain yield , mixing compost application at the rate 4 or 8 ton fed $^{-1}$ with either K-Humate or F.A gave the highest straw yield of wheat ; K-Humate gave the highest weight of 1000 grains. Finally the highest values of N , P and protein were obtained by compost applied at the rate 4 ton fed $^{-1}$, the lowest ones being found by mixing the conditioners .

Key words: *Compost, K- humate, fulvic acid, wheat yield, yield component, protein.*

INTRODUCTION

Today, there is a renewed interest in organic recycling to improve soil fertility and productivity. The periodical application of the natural organic wastes to the soil has gained momentum in the recent past and being called "organic agriculture, clean agriculture and bio agriculture" (Palm *et al,* 2001).

Robert. (2011) reported that humic acid is one of the most important components of bio-liquid complex it helps break up clay and compacted soils , and with increases in seed germination. Also Humic is not a fertilizer, but considered as a compliment to fertilizer(Mackowiak *et al* (2001) . On the other hand, Fulvic acids have oxygen content twice that of humic acids, they have many carboxyl (COOH) and hydroxyl (O H) groups. Also, Saruhan *et al.* (2011) added that, humic acid treatments raised the yield and yield components which were found to be statistically significant. The highest values for grain yields, 1000 grains weight, and crude protein were obtained. Robert (2011) showed that, as toxic soil conditions were remediated (corrected) and additional humate based fertilizers are applied, crop yields and product quality continue to improve. The positive impact of humic substances on plant growth can be reversed by applying excessively high concentrations of these fertilizers.

(Mackowiak *et al.,* 2001) showed that, humic acid (HA) is one of the most important components. Because of its molecular structure; it provides numerous benefits to crop production, increases seed germination rates, improves water, air and roots penetration. On the other hand, humic

substances are relatively cheap and able to complex many metals, including Fe, in addition to being source of N, P or S (Varanini and Pinton, 2001). Moreover Eletr *et al.,* (2013) revealed that, application of fulvic acid (FA) and humic substances (HS) led to decreases in pH and EC values of soil in both winter and summer seasons. On the other hand, all applied treatments increased significantly the organic matter (OM) content.

El- Maaz *et al.,* (2010) found that, EC, pH and $CaCO_3$ values were decreased as a result of using rice straw compost and chicken manure, the contents of OM being however increased.

The main target of this study is to evaluate the effect of some organic manures including a compost , potassium humate , fulvic acid and their combinations on soil chemical properties and wheat plant production as well as plant nutrient .

MATERIALS AND METHODS

A field experiments were conducted on clay loam soil at the Experimental Farm of Sakha Agriculture Research Station, Kafr El Shikh, Egypt during two successive seasons (2010/2011 and 2011/ 2012) cultivated with wheat crop (*Triticum aestivum* L., var Sakha 93). The experimental design was a randomized complete block design with three replicates, the plot area was 10.5m^2 (3 m width and 3.5 length), the recommended doses of NPK (100% NPK) alone as a control treatment were also included. Superphosphate (15.5 % P_2O_5) at the rate 200 kg fed^{-1} added basically before planting during soil preparation. Nitrogen added at the rate 400kg fed^{-1} in three equal doses after 15, 30 and 60 days from planting in the form of ammonium sulfate (20 % N) while, potassium added at the form potassium sulfate (48 % K_2O) at the rate 50 kg fed^{-1} in two equal doses at sowing and 30 days from planting .

Organic manure was used as compost applied at the rate either 4 or 8 ton fed^{-1}, both potassium humate (K- Humate) and fulvic acid (FA) at the rate 20 L fed^{1} 3%(v/v) being included. The compost used was thoroughly incorporated into the top soil (25 cm depth), two weeks before cultivation. K- Humate and fulvic acid were added as soil application at three times after 20, 40, and 60 days from planting.

The treatments involved 1) control (soil treated with 100 % NPK of recommended doses 2,3)soil treated with either K –H or F A 4, 5) soil treated with compost at the rate of either 4 or 8 ton fed^{-1} 6, 7) soil treated with mixture of K-H and either C4 or C8 (K-H+C4 and K- H +C8) 8, 9) soil treated with mixture of FA and either C4 or C8 (FA+ C4 and FA +C8)

Before planting surface soil sample (0-30) was taken from experimental field, air-dried, ground, sieved through a 2 mm sieve and analyzed for some soil physical and chemical characteristics of the studied soil, evaluated according to Klute (1986) and Page *et al.* (1982) are presented in Table (1). Some characteristics of compost, K-Humate and fulvic acid being including in Table (2 a, b). Soil samples were also collected from the surface layers (0-30) for all plots after harvest for the two studied seasons. The soil samples were air- dried and analyzed for some chemical characteristics, i.e., soil pH, organic matter and total calcium carbonate according to the methods described by Page *et al.* (1982). The total soluble salts were determined using electrical conductivity meter at 25 ^{0}C in soil paste extract (Jackson, 1973). Particle size distribution was carried out by the pipit method description by Gee and Bauder (1986) using sodium hexametaphosphate as a dispersing agent. Certain samples were digested as described by Jackson (1973) to determine the content of N, P and K. crude protein concentration was estimated according to Sarwar (1984). Obtained results were subjected to statistical analysis according to Snedecor and Cochran (1980) and the treatments were compared by using the least significant difference (L. S. D at 0.05 level of probability)

Table (1): Some physical and chemical properties of the studied soil

characteristic	value
Particle size distribution (%)	
Coarse Sand	22
Find sand	18
Silt	28
Clay	32
Texture class	Clay loam
Chemical analysis	
pH(1:2.5soil suspension)	7.97
Total carbonate (%)	3.17
Organic matter (%)	1.46
EC, dS/m soil paste	1.52
Soluble cations (meq/L)	
Ca^{++}	7.0
Mg^{++}	5.0
Na^{+}	2.9
K^{+}	0.3
Soluble anions (meq/L)	
CO_3^{--}	
HCO_3^{-}	-
Cl^{-}	4.2
SO_4	5.6
	5.4

Table (2 a). Some characteristics of applied compost.

analysis	values
Moisture %	13.0
pH (1:10)	8.18
EC dS m^{-1}	3.25
OM %	25.7
C : N	26.62
Total N %	0.56
Total P %	0.39
Total K %	0.65

Table (2 b). Some characteristics of applied K-Humate and FA acid.

Determination	K- Humate	Fulvic acid
EC dS m^{-1}	58.0	56.0
pH	5.08	2.50
Total N %	1.29	1.11
Total P %	0.15	0.12
Total K %	0.98	0.98

RESULTS AND DISCUSSION

Soil chemical properties:-

To shed light on the effect of different treatments under study on some soil chemical properties, Table (3) was designed. Regarding the pH values of the studied soil samples, it was evident that, these soils were generally slightly alkaline, as the soil pH values ranged from 7.5 to 7.9. Data in Table (3) indicated that, the lowest values of soil pH were samples treated by K-H +C8 and FA + C8. Thus it can be concluded that, the different organic manures play an important role in reduction of soil pH of the studied soil. Also, data in Table (3) showed the effect of compost, K-Humate and FA on EC, OM and $CaCO_3$ content of the studied soil. Data indicated decreases in both EC, and $CaCO_3$ particularly with mixing both compost treatments of (4 and 8 ton fed $^{-1}$) and either K-Humate or FA acid compared to each of them applied alone, the treatment K-H+C8 showed the highest effect. Organic matter % increased, particularly with mixing both compost (4 and 8 ton fed $^{-1}$ and either of K-Humate or FA acid compared to the control (NPK % recommended). These results are similar to the findings of EL-Maaz, et al. (2010). Concerning the effect of organic matter as compost, FA and HA on the decreasing soil pH, their effect illustrated by the indirect effect in decreasing sodium and the direct effect of organic acids, which formed either during decomposition of compost or by the application of HA and FA (Abedl- Fattah 2012).

Plant behavior:

Dry matter production (yield):-

Data in Table (4) showed that, the organic manure as compost, K-H and FA resulted in increases in wheat grain, straw and 1000 grains weight. The magnitude of increase depended on the type of OM applied. The highest grain yield values were obtained under 4 ton fed $^{-1}$ compost applied alone or combined with K-H treatments. On the other hand, data showed that, the highest straw yield values were found with 4 ton fed $^{-1}$ compost and FA +8 ton fed $^{-1}$ compost addition. Saruhan et al (2011) revealed that humic compounds added to soil increased the soil fertility through increasing the soil microbial population including beneficial microorganisms. Thy explained that humic substances are major components of organic matter, often consisting 60 to 70 % of the total organic matter, thus they may enhance the plant nutrients uptake through stimulation of microbiological activity. Ulkan (2008) postulated that addition of humic acid to soil in wheat cultivation stimulated the soil microbiological activity that led to increase the soil fertility. These results are in agreement with the results of El-Maaz et al. (2010) and Eletr et al. (2013).

Table (3). Effect of compost, K-Humate and fulvic acid on some soil chemical properties of the studied soil.

Treatment	pH 1:2.5	EC dS m $^{-1}$	OM %	$CaCO_3$ %
Control (100%NPK)	7.90	1.97	1.58	2.96
K- Humate	7.61	1.63	1.63	2.33
FA	7.78	1.65	1.60	2.12
C4	7.72	1.38	1.65	2.54
C8	7.69	1.28	1.73	2.33
K-H+C4	7.65	1.08	1.69	2.32
K-H+C8	7.50	0.95	1.82	2.12
FA+C4	7.70	1.17	1.73	2.45
FA+C8	7.63	1.09	2.10	2.15

Table (4). Grain and straw yields and weight of 1000 grains of wheat as affected by different treatments under study.

Treatment	Grain yield ton fed $^{-1}$	Straw yield ton fed $^{-1}$	weight of 1000 grains gm)(
Control (100%NPK)	2.445	4.696	40.53
K- H	2.813	4.046	46.16
FA	3.183	4.518	45.20
C4	3.362	4.896	42.00
C8	3.030	3.966	40.96
K-H+C4	3.203	4.496	45.53
K-H+C8	2.751	3.276	43.83
FA+C4	2.656	4.683	42.43
FA+C8	2.678	5.023	40.43
LSD. 5 %	0.206 **	0.668 **	5.37 *

Mixing of soil conditioners may give the lowest value of yield and weight of 1000 grains as to give the highest values of straw with huge of vegetative growth, and small grain. (Robert 2011) reported that, as toxic soil conditions remediated (corrected) and additional humate based fertilizers are applied, crop yields and product quality continue to improve. Also, added avoid applying excess fertilizers (of any type) to soils or plant surfaces. Individuals who apply fertilizers to soils (e.g. Producers, farmers and gardeners) should keep in mind that excessive applications of any fertilizer can create imbalance's and even reduce soil fertility. The positive impact of humic substances on plant growth can be reversed by applying excessively high concentrations of these fertilizers.

Nutritional status

Data in Table (5) showed that concentration of N, P and K along with protein in grain and straw yields increase with the studied treatments; K concentration was not affected. Regarding N concentration and calculated protein , data in Table 5) showed that, values in grain was slightly influenced by different treatments under study, the maximum increase was obtained under 4 ton fed $^{-1}$ of compost addition. These results are in agreement with the results of El-Maaz *et al.* 2010 , Saruhan *et al.,* 2011 and Eletr *et al.,* 2013.

Table (5): Effect of compost, K-Humat and fulvic acid on N, P and K (%) in wheat grain and straw along with protein content .

Treatment	grain				straw		
	Protein content	N %	P %	K %	N %	P %	K %
Control (100%NPK)	11.27	1.96	0.350	0.329	0.52	0.068	1.743
K- H	10.92	1.90	0.359	0.306	0.50	0.117	1.315
FA	11.27	1.96	0.431	0.272	0.51	0.221	1.570
C4	12.82	2.23	0.405	0.288	0.56	0.111	1.190
C8	10.92	1.90	0.396	0.322	0.55	0.163	1.486
K-H+C4	10.92	1.90	0.371	0.242	0.45	0.127	1.496
K-H+C8	10.35	1.80	0.359	0.314	0.44	0.152	1.426
FA+C4	11.84	2.06	0.346	0.283	0.54	0.065	1.593
FA+C8	12.42	2.16	0.384	0.328	0.55	0.121	1.803

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تقييم إستخدام الكمبوست وهيومات البوتاسيوم و حمض الفالفيك ومخاليطها على بعض الخواص الكيميائية للأرض وإنتاجية القمح

وفاء محمد طه العطر ، ناصر إبراهيم على طلحه ، ناهد أحمد محمد الصاوى عياد

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الملخص العربى

أقيمت تجربة حقلية في مزرعة محطة بحوث سخا بمحافظة كفر الشيخ بغرض دراسة تأثير و مقارنة بعض الأسمدة العضوية علي بعض الخواص الكيميائية للأرض وإنتاجية محصول القمح (سخا ٩٣) خلال موسمى ٢٠١٠/٢٠١١ و ٢٠١١/٢٠١٢ وذلك فى تصميم قطاعات تامة العشوائية لدراسة التأثير الفردى والمشترك لكل من حمض الفالفيك وهيومات البوتاسيوم والكمبوست وكانت معاملات الدراسة هي

١ – كنترول ١٠٠% NPK بالمعدل الموصي به لمحصول القمح

٢ – هيومات البوتاسيوم بمعدل ٢٠ لتر / فدان

٣ – حمض الفالفيك بمعدل ٢٠ لتر / فدان

٤ – كمبوست بمعدل ٤طن/ فدان

٥– كمبوست بمعدل ٨ طن / فدان

٦– كمبوست ٤ طن / فدان + هيومات البوتاسيوم

٧– كمبوست ٨ طن / فدان + هيومات البوتاسيوم

٨– كمبوست ٤ طن / فدان + حمض الفالفيك

٩– كمبوست ٨ طن/ فدان + حمض الفالفيك

وكانت أهم النتائج كالأتي :

١- إنخفاض قيم كل من حموضة التربة ومحتوى الأملاح ومحتوى التربة من كربونات الكالسيوم مع كل المعاملات المضافة بينما زادت نسبة المادة العضوية

٢- كان تأثيرخلط الأسمد ة العضوية على بعض الخواص الكيميائية أكبر من إستخدامها منفردة

٣- كان تأثير المعاملات عالي المعنوية علي محصول الحبوب والقش لمحصول القمح بينما كان التأثير معنويا مع قيم وزن ١٠٠٠ حبه .

٤- كانت إضافة الكمبوست بمعدل ٤ طن / فدان له تأثير واضح في زيادة محصول الحبوب والقش بينما كانت معاملات مخاليط الأسمدة غير مؤثرة علي المحصول الكلي للقمح (حبوب + قش)

٥- أظهرت النتائج تفوق محتوي النتروجين بكل من القش والحبوب تحت نأثير إضافة الكمبوست بمعدل ٤ طن / فدان أما بالنسبة للفوسفور فكانت الزيادة تحت نأثير إضافة حمض الفالفيك منفردا

٦- لم تتأثر قيم البوتاسيوم في كل من الحبوب والقش تحت معاملات البحث .

٧- محتوي البروتين فى حبوب القمح كان مرتبط بقيم محصول القمح من الحبوب بنفس المعاملات.