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COMPARISON BETWEEN THE INFLUENCE OF EFFECTIVE MICROORGANISMS (EM) OR HUMIC ACID (HA) WITH ORGANIC AND INORGANIC FERTILIZERS ON WHEAT PLANTS

Magda A. Ewais, Awatef A. Mahmoud and M.M. El-Shouny
Soil, Water and Environment Res. Inst., Agric.Res. Center, Giza, Egypt.
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ABSTRACTA: *field experiment was carried out at Abou-El-Ghr village, Kafre El-Ziyat District, El-Gharbia Governorate (30° 47 ˉ 05.54´N 30° 52 ˉ 13.28´ E elevation 8m) during the two growing successive seasons of 2008/2009 and 2009/2010 to study the effects of effective microorganisms (EM) and/or Humic acid (HA) with organic and/or inorganic fertilizers on wheat plants (Variety Sakha, 93) yield and its components as well as N, P and K uptake. The treatments were arranged in a split plot design with three replicates, combined analysis over all two year's for all data performed, the obtained results could summarize as follow:*

- *Chemical fertilizer (as NPK recommended) had a significant effect on grain, straw, biological yield and 1000 weight of grains compared with addition of FYM, the increase values about 13.01, 10.11, 11.25 and 23.40% respectively.*
- *Wheat yield and its components were significantly affected by using EM and HA (as foliar spray) comparing with control treatments. The highest values obtained by using HA as a foliar spray.*
- *Wheat yield and its components greatly increased due to the combined treatment of foliar spray with EM and HA which was found markedly higher and generally superior as compared to either EM or HA individually, this superiority was found with (50% rFYM + 50% rNPK).*
- *Using both effective microorganisms (EM) and humic acid (H.A) as a foliar application had significantly increased N, P and K uptake by grain of wheat plant.*
- *It can be concluded that the application of EM and HA as a foliar application with organic fertilizers are important for sustainable agriculture, economically by reducing the cost using N fertilizer.*

Key words: *Carbohydrate, Effective microorganisms (EM), Foliar spray, FYM, Grain yield, Humic acid (H.A), NPK-uptake, Protein, and Wheat plant.*

INTRODUCTION

Wheat is considered the main source of food in the world as well as in Egypt. Rising of wheat production through increasing the productivity of land area unit and the cultivated area, which is the most important national target to minimize the gap between the Egyptian production and consumption. To overcome this problem, attention has been paid to improve the quantity and quality of total production through improving the soil properties, good management of soil fertilization and foliar spraying of some Bio-organic amendments.

Organic matter application to soils is known to improve soil properties and consequently the plant growth. Among the types of organic matter, farmyard manure could be one of the most economical ways to increase organic matter content in soil. Several investigators indicated that the application of FYM increased plant growth and dry matter production (Khalil *et al.,* 2000). Organic fertilizer is considered as an important source of humus, macro and microelements carrier and at the same time increases the activity of the beneficial microorganisms (El-Gizy, 1994). Dahdouh *et al.,* (1999), found that organic manures play an important role in nutrients solubility as activate physiological and biochemical processes in plant leading to increase the plant growth and nutrients uptake. The best means of maintaining soil fertility and productivity level could be achieved through periodic addition of proper organic materials in combination with inorganic fertilizer (El-Fayoumy *et al.,* 2001).

It worth to mention that, application of FYM alone is not sufficient to face plant demand of nutrients, thus it could be important to use chemical fertilizers to attain the plant nutrients requirements.

Humic acid is a commercial product contains many elements which improve the soil fertility and increasing the availability of nutrient elements and consequently affected plant growth and yield. Humic acid particularly is used to remove or decrease the negative effects of chemical fertilizers and some chemicals from the soil. Humic substances have many beneficial effects on soil and consequently on plant growth and are shown highly hormonal activity. These materials not only increase macronutrients contents and ion uptake but also enhance micronutrients of the plant organs (Brunetti *et al.,* 2005).Salhyabama *et al.*, (2004) reported that humic acid increased yield and N, P and K uptake in rice plant. Studies on the effects of foliar applications of humic acids on wheat are limited. Several researchers El-Desuki (2004) and Shaaban *et al.,* (2009), have concluded that humic acid as foliar spray increased growth, nutrient uptake and yield and improved the quality of crops; this may reduce the NPK applied as soil application which decreases pollution and costs. Humic substances supply growing plants with food, make soil more fertile and productive increase the water holding capacity of soil; therefore, it helps plants resist droughts and stimulates seed germination. Humic acid reduces other fertilizer requirements, increases yield in crops, improved drainage, increases aeration of the soil, increases the protein and mineral contents of most crops and establish a desirable environment for microorganisms' development.

Application of effective microorganisms (EM) technology is introduced to the nature farming system. Whereas, EM applications have proved effective in many aspects and played important roles in promoting crop production and purifying the environment (Kato *et al.,* 1999). Shimoji and Higa (1999) suggested that, the foliar sprays of EM, enhance antioxidant properties and function within plant, it also increased the quality of harvested products.

EM is a mixed culture of beneficial microorganisms such as photosynthetic bacteria (Rhodopseudomonas Sp.), Lactic acid bacteria (Lactobacillus Sp.), Yeast (Saccharomyces Sp.) and fermenting fungi (Higa and Wididana, 1991; Higa and Parr, 1994). These microorganisms multiply in soil and develop beneficial effects such as releasing nutrients from organic sources and improving soil properties and penetration of roots (Ho in Ho and Hwan, 2000). Also, these microorganisms improve crop growth and yield by increasing photosynthesis, producing bioactive substances such as hormones and enzymes, controlling soil diseases and accelerating decomposition of lignin materials in the soil (Higa 2000).

The objective of this study is comparing the influence of humic acid and/or effective microorganisms (EM) with organic and/or inorganic fertilizers on yield of wheat plant and its components as well as chemical measurements.

MATERIALS AND METHODS

A field experiment was carried out at Abou El-Ghr village, Kafre El-Ziyat District, El-Gharbia Governorate (30° 47' 05.54'N 30° 52' 13.28'E elevation 8m) , during the two growing successive seasons of 2008/2009 and 2009/2010, to study the effects of effective microorganisms (EM) and/or humic acid (HA) with organic and/or inorganic fertilizers on wheat plants (Varity Sakha 93). Soil samples (0-30 cm depth) were taken before the performance of the experiments. Some soil physical and chemical analyses were performed according to Black (1965) as shown in Table (1).Some chemical properties of farmyard manure were determined according to methods by Jakson (1973) and data are presented in Table (2). A split-plot design with three replicates, where the fertilizer sources were allocated in the main plots as follow:

A- Organic fertilizers: as farmyard (FYM) 20 m^3/fed.

B- Inorganic fertilizers: as the recommended rates of N, P and K.

C- Combined treatment consist of 50% recommended dose from FYM+50% recommended dose from NPK(50% FYM +50% NPK).

The assistance treatments were allocated in the sub plots as follows:

1- Control treatment (foliar spraying with tap water).

2- Effective microorganisms (EM) was added at a rate of 4 L/fed. (Fed. =4200m^2) as a foliar spray application (diluted 1:100), three times, once every month starting from cultivation. EM is a biological solution produced by Affrosestation and Environment Administration, Ministry of Agric., Egypt, in association with EMRO Organization, Okinawa, Japan.

3- Humic acid (HA) is applied as potassium humate (K-humate) at a rate of 2 kg/fed. (50 mg/L) as a foliar spray, three times, once every month starting from planting.

4- Mixtured from No.2 and 3 (EM + H A) treatments

All solutions were foliar sprayed on the plants at a rate 400 L/fed. for each one alone or combined, three times, once every month starting from sowing. Some characteristic of K-humate as show in Table (3)

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

Soil properties	Value
Particle size distribution %	
Coarse sand	6.95
Fine sand	22.80
Silt	37.90
Clay	32.35
Textural class	Clay loam
Chemical analysis	
EC (dSm^{-1}) 1 : 5, soil paste extracted	2.45
pH (1 : 2.5, soil suspension)	7.92
Organic matter %	1.62
Total $CaCO_3$ %	1.84
Soluble anions (meq/L)	
$CO^{=}_3$	0.00
HCo^-_3	1.95
Cl^-	14.80
$SO^{=}_4$	7.80
Soluble cations (meq/L)	
Ca^{++}	7.95
Mg^{++}	3.81
Na^+	11.69
K^+	1.10
Available macronutrients (mg kg^{-1} soil)	
N	38.20
P	6.30
K	185.4
Available micronutrients (µg kg^{-1} soil)(DTPA extraction)	
Fe	61.70
Mn	28.90
Zn	32.40
Cu	9.80

Table (2): Some chemical properties of the used farmyard manure.

Properties	Value
pH (1 : 2.5 manure suspension)	7.60
EC dSm^{-1}	3.88
Organic matter (%)	25.60
Organic carbon (%)	14.85
Total N (%)	1.28
C/N ratio	11.6:1
Total P (%)	0.09
Total K (%)	2.15
Total micronutrients ($\mu g\ g^{-1}$ FYM)	
Fe	86.90
Mn	39.65
Zn	32.72
Cu	8.96

Table (3): Chemical properties of humic substances.

pH	Ec	OM %	O.C	C/N	Macronutrients (%)			Micronutrients (mg Kg^{-1})		
					N	P	K	Fe	Zn	Mn
7.83	0.94	68	39.44	18.87	2.09	0.15	3.42	415	258	214

The main species included in EM

Effective Microorganisms(EM)**	
Lactobacilli	Yeasts
Lactobacillus plantarum	*Saccharomyces spp*
Lactobacillus casei	*Actenomycetes (Streptomyces spp)*
Streptococcus lactis	Ray fungi
Photosynthetic baceria	*Streptomyces albus*
Rhodopseudomonas plastris	*Treptomyces griseus*
Rhodobacter sphacrodes	Fungi:
	Aspergillus oryze

** according to Kato *et al.,* (1999)

The FYM was thoroughly incorporated in the soils before planting. Phosphorus fertilizer (15 kg P_2O_5/fed) as single calcium super-phosphate (15% P_2O_5) was added with land preparation. Potassium fertilizer 24 kg K_2O /fed. was added as potassium sulphate (48% K_2O) before the 1st irrigation. While the mineral nitrogen fertilizer (ammonium sulphate 20.6% N) at the rate of 80kgN/fed. was supplied in three equal doses .Each experimental plot was 3.5m X 3m occupying an area of $10.5m^2$(i.e. 1/400 fed.)

At harvesting time, the following characteristics were estimated:

1- Yield and its components such as plant height (cm), Grain weight/spike, Grain weight/ plant (g), 1000 grain weight (g), Grain, Straw and Biological yields (kg/fed) .

2- Chemical analysis included percentages and uptakes N,P and K in grains as well as N content, protein and carbohydrate % as following : grain samples were taken for chemical analysis to determine N,P and K percentages in grains and then N,P and K content in grains were calculated according to the methods described by Chapman and Pratt (1961). Crude protein in grains (kg/fed.) was calculated by multiplying the values of N content in grains (kg/fed.) by 5.7, according to A.O.A.C (1980). Carbohydrate % was determined according to Smith *et al.*, (1956).Results for all studied parameters were statistically analyzed using the combined analysis of the two growing seasons according to Gomez and Gomez (1984). The least significant differences (L.S.D.) at 5% level of significance, were used.

RESULTS AND DISCUSSION

1. Effect of assistance treatment with FYM and/or chemical fertilizer on plant growth parameters.

1.1. Effect of fertilization sources:

Data presented in Table (4) showed that the values of plant height (cm), spike length (cm), number of grains/spike, grain weight/ spike (g) and 1000 grains weight (g) of plants significantly differed due to the variation of different treatments. It is clear that NPK treatment was more effective than FYM ones in this respect. The data revealed also that, the combined application of chemical NPK fertilizers with FYM significantly increased plant height, spike length, number of grains/ spike, grain weight/spike and 1000-grains weight compared with applying chemical NPK fertilizers or FYM alone. The favorable effect of mixed FYM with chemical NPK fertilizers may be due to the effect of FYM on increasing the efficiency of chemical NPK fertilizer, in addition to supply of many other essential nutrients.

In fact, organic fertilizers which include FYM are one of the natural amendments which applied to correct and improve the physical, chemical and biological properties of the soil and this consequently encourage the plant to have a good growth. Adding of manures increases the percentage of organic matter in the soil. Organic matter increment in coarse-textured soils contribute to reduce the leaching out of nutrients through: (1) improving soil structure toward maximizing the ability of this soil to retain and conserve irrigation water against rapid loss by leaching and deep percolation and (2) ability of the active groups of organic matter (Fulvic and humic acids) to retain the inorganic elements in complex and chelate forms which broken down slowly by soil microorganisms and release the elements over a period of time. The extent of availability of such nutrients depends on the type of organic materials and microorganisms and the slow released nutrients permit the plants to benefit of them (Saha *et al.,* 1995). Similar trends were obtained by Abd El-Rasoul and El-Azzouni (2002).

1.2. Effect of foliar nutrition treatments:

Studied foliar nutrition treatments i.e. HA and EM and their mixture (HA + EM) had a significant effect on plant height, spike length, number of grains/ spike, grain weight/ spike and 1000-grains weight of wheat plants as shown in Table (4). Foliar application with HA associated with obvious improvement in all studied character as compared with foliar application of EM. The statistical analysis for data in the same Table clearly indicates that application of HA + EM mixture was the best treatment to produce the highest values of all studied characters followed by HA / EM. These results could be explained according to the findings of Cheng *et al.*, (1998) who stated that humic acid enhanced the water retention, increased the ability rate of leaves for photosynthesis process, increased the grain filling intensity, enhanced the drought resistance of plants and increased its thousand grains weights. These results are in agreement with those obtained by Taha *et al.*, (2006) and Verlinden *et al.*, (2009).

Table (4): Effect of interaction between source of fertilizers and foliar application with EM and/or HA on yield and its components of wheat plants in 2008/2009 and 2009/2010seasons as well as combined analysis.

treatments		Plant height (cm)	Spike length (cm)	No. of grains/ spike	Grain weight/ spike (g)	1000- grain weight (g)
Fertilizers sources	Foliar application					
FYM	Control	96.8	10.6	47.3	2.29	38.18
	EM	102.2	11.5	49.7	2.36	44.52
	H.A	106.3	11.9	52.3	2.45	48.60
	H.A + EM	109.6	12.5	57.7	2.55	52.88
	Mean	103.73	11.63	51.75	2.41	46.05
NPK	Control	105.3	11.6	51.7	2.49	47.32
	EM	109.2	12.4	54.3	2.51	50.59
	H.A	113.7	12.7	57.3	2.59	54.29
	H.A + EM	116.8	13.5	61.7	2.62	57.82
	Mean	111.25	12.55	56.25	2.55	52.51
50% r FYM + 50% r NPK	Control	112.8	12.5	53.3	2.56	52.33
	EM	115.5	13.4	56.3	2.62	55.61
	H.A	118.4	14.3	62.7	2.67	59.77
	H.A + EM	121.5	14.6	65.3	2.70	66.72
	Mean	117.05	13.7	59.4	2.64	58.61
Mean of foliar application	Control	104.97	11.57	50.77	2.45	45.94
	EM	108.97	12.43	53.43	2.50	50.24
	H.A	112.80	12.97	57.43	2.57	54.22
	H.A + EM	115.97	13.53	61.57	2.62	59.14
L.S.D at 5 %						
Fertilization sources:(A)		1.90	0.42	2.36	0.02	1.34
Foliar application: (B)		1.82	0.44	1.59	0.02	1.39
Interaction: (AXB)		3.14	0.76	2.75	0.04	3.15

*every value represents means of three replicates

Also, Pati and Chandra (1981) reported that foliar application of EM results in a large number of beneficial microorganisms at the leaf surface, or phyllospher. It is believed that certain microorganisms in EM culture including photosynthetic bacteria and N-fixing bacteria which can enhance the plants photosynthetic rate and efficiency of N-fixing capacity as well. These results were in accordance with (Arshad and Shah, 2010).

1.3. Interaction effect:

The interaction between the sources of fertilizer i.e. FYM and/or chemical fertilizer and foliar nutrition treatments had a significant effect on all studied characters. These results were in accordance with Shahaby *et al.,* (2001) and Salib *et al.,* (2002).

2. Effect of assistance treatment with FYM and/or chemical fertilizer on wheat yield and its components.

2.1. Effect of fertilization sources:

As shown in Table (5), the results illustrate application of chemical NPK fertilizers, FYM and their mixtures had a significant effect on grain, straw, biological yields as well as protein yield and carbohydrate (%). Combination of FYM and chemical NPK fertilizers gave a significant increase in yield and its components. Chemical fertilizers are considered as available source of macro-and micronutrients, but the elements are leached easily. On contrary, the organic fertilizers are considering as sufficient slow released fertilizers. Combining the chemical NPK fertilizers with the FYM supplies the plants with sufficient and available nutrients besides, reducing the leaching of the elements. This will enable more plants to be developed and give enough time for grains filling. The enhancing effect of the combinations between FYM and chemical N, P and K fertilizers on the yield and yield components could be attributed to the increase in grain weight /spike and 1000-grain weight (Table 4) which resulted in more accumulation of stored food in grains. Thus the response of wheat plants to the combinations between FYM and chemical NPK fertilizers may give the possibility to substitute the chemical NPK fertilizers partially by FYM. Also, a combination between the FYM and chemical N, P and K fertilizers gave the best results as compared with the treated plants with NPK or FYM alone.

The beneficial effect of both mineral fertilizers and organic manure on yield may be due to the vigorous vegetative growth, which may be attributed to the addition of mineral fertilizers and the organic materials on increasing the availability of elements (macro and micronutrients) to be absorbed by plant roots. The elements play important roles in the metabolic processes like photosynthesis, respiration and carbohydrate synthesis. The effect of N may be attributed to its role in increasing top and root growth, altering plant metabolism and increasing solubility and availability of phosphorus. Also, these increasing in grain, straw, biological yields, protein content and carbohydrate (%) may be due to the phosphorus application rate which is known to help developing a more extensive root system and thus enabling plants to extract water and nutrients from more depth. Potassium is important for plant growth and is involved in every metabolic process, including carbohydrates metabolism, protein biosynthesis, assimilate translocation, conformation of enzymes and stomata movement. Similar results were reported by Seadh and Badawi (2006) and Mekhemar (2008).

Table (5): Effect of interaction between source of fertilizers and foliar application with EM and/or HA on yield and its components of wheat plants in 2008/2009 and 2009/2010 seasons as well as combined analysis.

Treatments		Grain yield (kg/fed)	Straw yield (kg/fed)	Biological yield (kg/fed)	Protein (%)	Protein yield (kg/fed)	Carbohydrate (%)
Fertilizers sources	Foliar application						
FYM	Control	2362.5	3660.0	6022.5	12.88	304.29	67.8
	EM	2497.5	3850.0	6347.5	13.05	325.92	68.5
	H.A	2629.5	3960.0	6589.5	13.51	355.25	68.7
	H.A + EM	2755.5	4160.0	6915.5	13.97	384.94	69.2
	Mean	2561.25	3907.5	6468.75	13.35	342.60	68.55
NPK	Control	2670.0	4030.0	6700.0	13.28	354.58	68.2
	EM	2796.0	4240.0	7036.0	13.57	379.42	69.3
	H.A	2838.0	4450.0	7288.0	13.74	389.94	69.8
	H.A + EM	2947.5	4580.0	7527.5	14.20	418.55	71.3
	Mean	2812.88	4325.0	7137.88	13.70	385.62	69.65
50% r FYM + 50% r NPK	Control	2919.0	4340.0	7256.00	13.57	395.70	68.5
	EM	3097.5	4540.0	7637.50	14.09	436.44	69.6
	H.A	3267.0	4690.0	7957.00	14.38	469.79	71.2
	H.A + EM	3414.0	4820.0	8234.00	14.49	494.69	71.5
	Mean	3173.63	4597.5	7771.13	14.13	449.16	70.2
Mean of foliar application	Control	2649.5	4010.0	6659.50	13.24	351.52	68.17
	EM	2797.0	4210.0	7007.00	13.57	380.59	69.13
	H.A	2911.5	4366.67	7278.17	13.88	405.00	69.9
	H.A + EM	3039.0	4520.0	7559.0	14.22	432.73	70.7
L.S.D at 5 %							
Fertilization sources:(A)		35.07	63.55	169.45	0.15	7.80	0.39
Foliar application: (B)		32.78	32.81	162.74	0.09	5.79	0.38
Interaction: (AXB)		57.35	53.74	281.40	0.16	26.66	0.66

2.2. Effect of foliar nutrition treatments:

Foliar nutrition treatments i.e. HA and EM and their mixture (HA + EM) had a significant effect on grain and straw yields/fed. as well as protein and carbohydrate percentages of wheat plants as shown in Table (5). Obtained data indicate that all aforementioned yield traits were significantly affected by foliar application with HA and/or EM compared with the control treatments. In this concern, the highest values were obtained by using HA followed by EM when compared with the control. However, the highest values of yield and its components were recorded in plants receiving the (HA + EM) and (50% rFYM + 50% rNPK), but the lowest values were recorded with those receiving the FYM without foliar application. The increases in grain yield/fed. caused by spraying with (HA + EM) may be attributed to the increase in yield components (number of grains/ spike and grains weight/ spike). These results are in agreement with those obtained by Sebastiano *et al.*, (2005). The positive effect of humic acid on plant growth and productivity, which seen to be mainly due to hormone like activities of the humic acids through their involvement in cell respiration, photosynthesis, oxidative phosphorylation, protein synthesis and various enzymatic reactions (Ali, laila and El-Bording 2009). Also, Humic substances associated with enzymes, can lead to the enhancement of activity of many enzymes (phosphorilase, phosphatase and cytachrome oxidase), to the inhibition of others (IAA oxidase, fitase and peroxidase), and to the synthesis of some such invertase (Verlinden *et al.*, 2009).

Protein content and total carbohydrate (%) in grains

Data in Table (5) show that, the amounts of protein and carbohydrate (%) in grains were significantly affected by application of FYM, chemical NPK fertilizers and their combinations.

The results in Table(5) reveal that, applying 50% rFYM combined with 50% rNPK fertilizers significantly increased the protein content in grains compared to the full recommended dose of chemical NPK or FYM alone. Similar trend was found for total carbohydrate percentage in grains. The increase in carbohydrate percentage may have been due to the effect of those nutrients on chlorophyll concentrations, activation of carboxylation and dehydrogenase enzymes of CO_2 - fixation, Mahrous *et al.*, (2010). However, the increase in protein percent was ascribed to effect on RNA synthesis which in turn plays an important role in protein biosynthesis, activity of nitrate reductase in leaves.

Moreover, the application of HA and EM as foliar treatment in presence of (50% r FYM+ 50% r NPK), more significant improvement on studied parameters were obtained. The combined treatment of HA + EM with (50% rFYM +50% rNPK) produced the significant effect on studied characters. Since total carbohydrate percent reached to 71.5% .This may be due to explained the role of humic acid in increasing the concentration of messengers ribonucleic acid, increases in enzymes synthesis and an increase in the crude protein and carbohydrates as found by Ali, laila and El-Bording 2009. Also,Habashy and Ali- laila, 2005 showed that foliar application of humic acid and EM increased grain protein and carbohydrates contents.

This may be attributed to the spraying of humic acid decrease the loss of soil moisture, increase ability rate of leaves for photosynthetic process, increased the grain filling intensity, enhanced the drought resistance of wheat plant (Habashy and Ali-Laila, 2005). However, Nardi *et al.*, (1999) showed that the biological activity of the humic substances was attributed to their chemical structure and to their functional groups, which could interact with hormone-binding proteins in the membrane systems, evoking a hormone-like response. The beneficial effect of those interactions could be attributable to enhancing the nutrients release easily in soil solution and to encourage penetration of roots, as well as to develop antagonistic impacts toward pests and diseases. (Sangakkara and Weeraskekera, 2001 and Ho in Ho and Hwan, 2000).

2.3. Interaction effect:

The interaction between the sources of fertilizer i.e. FYM and chemical fertilizer and foliar nutrition treatments H.A and/or EM produced the highest grain yield and best quality characters of grains. The best interaction treatment was obtained by using 50% rFYM + 50% rNPK and mixture of (HA + EM), which resulted in the highest mean values of all the studied traits.

3. Effect of assistance treatment with FYM and/or chemical fertilizer on chemical composition of grains.

3.1. Effect of fertilization sources:

Data in Table (6) demonstrate that N, P and K concentration and uptake in grains at harvest were significantly influenced by different treatments. All the combination between 50% FYM and chemical 50% NPK fertilizers significantly increased N, P and K (%) and their uptake in wheat grains compared to 100% of chemical NPK fertilizers or with FYM only. These results may be attributed to the high capacity of the plants received such nutrients in anabolic metabolites which reflect on more vigorous plant growth and strong rooting system which in turn contributes to increase in N, P and K concentration and uptake. These results in agreement with that observed by Soliman (2007) who obtained a significant increase in N, P and K contents in wheat as a result of combined effect of organic and inorganic NPK fertilizers applied to soil. In this respect, Reda *et al.*, (2006) showed that application of organic manure combined with chemical NPK fertilizers gave the highest values of N, P and K uptake by wheat. On the other hand, the lowest values in N, P and K (%) in the leaves and grains were produced from the plants fertilized with FYM only. These results are in accordance with those obtained by Salib *et al.*, (2002).

3.2. Effect of foliar application EM and/or HA

Data illustrated in Table (6) showed that spraying both EM and/or HA with FYM and/or NPK significantly increased N, P and K uptake by grains of wheat plant comparing with control treatment .The recognized role of EM treatment for enhancing the nutrients uptake turns to that EM accelerates the mineralization processes of organic matter and help nutrients releasing to the plants, (Yadav, 1999).

Table (6): Effect of interaction between source of fertilizer and foliar application with EM and/or HA on NPK concentration and its uptake by wheat grains in 2008/2009 and 2009/2010seasons as well as combined analysis.

Fertilizers sources	Foliar application	N (%)	N-uptake (kg/fed)	P (%)	P-uptake (kg/fed)	K (%)	K-uptake (kg/fed)
FYM	Control	2.24	52.92	0.45	10.63	0.657	15.52
	EM	2.27	56.69	0.47	11.74	0.673	16.81
	H.A	2.35	61.79	0.48	12.62	0.682	18.01
	H.A + EM	2.43	66.96	0.50	13.78	0.688	18.96
	Mean	2.32	59.59	0.49	12.19	0.676	17.33
NPK	Control	2.31	61.68	0.51	13.62	0.665	17.76
	EM	2.36	65.99	0.53	14.82	0.678	18.96
	H.A	2.39	67.83	0.54	15.33	0.692	18.64
	H.A + EM	2.47	72.80	0.55	16.21	0.700	20.63
	Mean	2.38	67.08	0.53	15.00	0.684	19.25
50% r FYM + 50% r NPK	Control	2.36	68.82	0.53	15.45	0.678	19.77
	EM	2.45	75.89	0.54	16.73	0.702	21.74
	H.A	2.50	81.68	0.55	17.97	0.725	23.69
	H.A + EM	2.52	86.03	0.56	19.12	0.728	24.85
	Mean	2.46	78.11	0.55	17.32	0.708	22.51
Mean of foliar application	Control	2.30	61.14	0.50	13.23	0.667	17.68
	EM	2.36	66.19	0.51	14.43	0.684	19.17
	H.A	2.41	70.43	0.52	15.31	0.701	20.45
	H.A + EM	2.47	75.26	0.54	16.37	0.705	21.48
L.S.D at 5 %							
Fertilization sources:(A)		0.03	1.13	0.02	0.58	0.02	0.18
Foliar application: (B)		0.02	0.80	0.01	0.44	0.02	0.23
Interaction: (AXB)		0.03	1.37	0.02	0.73	0.03	0.40

Also, data presented in Table (6) should that soil fertilizers application with humic acid as foliar application lead to increase in N, P and K uptake in wheat grains, as compared to the recommended dose of fertilizer alone. Soil fertilizers application and foliar application of humic acid can increase cell permeability which makes better penetration of NPK fertilizers into the leaf and then to other organs, which improve the root growth and its ability to nutrients absorption and easily travel inside organs of plants and assimilated, this lead to improvement of nutrients uptake. (Shaaban *et al.*, 2009) found that foliar application improved root growth and led to greater absorbing surface, also, (Guvenc *et al.*, 1999) found that nutrient contents of leaves treated with foliar humic acid were significantly higher than those of control. (Neri *et al.*, 2002) mentioned that it can be hypothesized that humic acid reduce the speed of droplet drying while their wetting action may enhance nutrient absorption. The results clearly indicated that humic acid can be used on foliage to make more efficient utilization of nutrients.

3.3. Interaction effects:

With regard to the effect of interactions between source of fertilizers and foliar application EM and/or HA on nutrients uptake by grain, data in Table (6) showed that NPK uptake significantly increased by using EM + HA as a foliar spray combined with 50% rFYM. + 50% rNPK, comparing with other treatments.

Conclusion

As a conclusion, the obtained results ensure the importance of foliar application with EM + HA in increasing nutrient availability, enhancing plant growth and improving the yield of wheat plant (YU *et al.,* 1999) and its help in improving the soil characteristics on the micro flora of the soil, which in turn increased the crop yield considerably (Riad, *et al.,* 2002).

Also, the FYM have great importance in increasing wheat productivity beside the role of effectiveness of microorganism EM + HA in increasing nutrient availability, enhancing plant growth and improving the yield of wheat plant.

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مقارنه بين تأثير الكائنات الحية الدقيقة النافعة (EM) أو حامض الهيوميك مع التسميد العضوي والمعدني على نباتات القمح

ماجدة على عويس – عواطف عبد المجيد محمود – مطاوع مطاوع الشوني
معهد بحوث الأراضي والمياه والبيئة – مركز البحوث الزراعية – الجيزة – مصر

الملخص العربي

أقيمت تجربة حقلية بقرية أبو الغر ـ كفر الزيات ـ محافظة الغربية خلال موسمي ٢٠٠٨/٢٠٠٩ و ٢٠٠٩/٢٠١٠ وذلك لدراسة تأثير كل من الكائنات الحية الدقيقة النافعة (EM) وحمض الهيوميك مع أو كلا على حدة فى وجود التسميد العضوي أو المعدني أو كلاهما معا على محصول القمح (صنف سخا ٩٣) ومكوناته وأيضا عناصر النيتروجين والفوسفور والبوتاسيوم الممتص في الحبوب

تم تصميم التجربة في قطع منشقة في ثلاثة مكررات.

وتتلخص النتائج المتحصل عليها فيما يلي:

ـ تأثر كل من محصول الحبوب والقش والمحصول الكلى ووزن الألف حبة تأثرا معنويا بمصدر التسميد حيث تفوق التسميد الكيماوي على التسميد العضوي (السماد البلدي).

ـ كان لاستخدام حمض الهيوميك وكذلك الكائنات الحية الدقيقة النافعة (EM) تأثيرا معنويا على المحصول ومكوناته مقارنة بمعاملة الكنترول . أعلى قيم للصفات المدروسة سجلت عند استخدام حامض الهيوميك (HA) كمحلول رش .

ـ تفوقت المعاملة المشتركة لمادتي الرش والتي تشتمل (الكائنات الحية الدقيقة النافعة EM+ حامض الهيوميك) على المعاملات المنفردة بإحدهما مما أدى إلى زيادة في محصول القمح ومكوناته. ومسجلة أعلى قيم فى الموسمين خاصة مع (٥٠% من السماد الكيماوي + ٥٠% من التسميد العضوي)

ـ كان لاستخدام الكائنات الحية الدقيقة النافعة (EM) وحامض الهيوميك رشا على النبات تأثير معنويا على امتصاص الحبوب لعناصر النتروجين والفوسفور والبوتاسيوم .

ـ أوضحت النتائج أهمية إضافة الكائنات الحية الدقيقة النافعة (EM) وحامض الهيوميك مع التسميد العضوي كبدائل زراعية واقتصادية وذلك لتقليل السماد النتروجيني الكيماوي.