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EFFECT OF SOME HUMIC ACIDS ON WHEAT PLANT GROWN IN DIFFERENT SOILS

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ABSTRACT

A pot experiment was conducted to study the effect of four humic acids extracted from different composts on wheat plant (Triticum aestivum L. cv. Yecora rojo) grown in a highly calcareous loamy sand soil ($CaCO_3$=28%) and in noncalcareous sandy soil ($CaCO_3$= 4.2%). The humic acids were applied at five rates (0, 50, 100, 150, and 200 kg ha^{-1}). All pots received 30% of the recommended amounts of inorganic fertilizers (N, P and K).

The obtained data show that the available nutrients (P, K, Fe, Mn, Zn and Cu) were higher in noncalcareous soil in compared to the calcareous soil. The results also show that increasing the rates of the investigated humic acids resulted in an increase in the organic matter content in the two studied soils , the macro and micronutrients uptake (N, P, K, Fe, Mn, Zn and Cu) by wheat plant and its yield (grain and straw).

Application of humic acid which extracted from the animal compost gave the highest values of available nutrients, organic matter content, yield and yield components as well as nutrients uptake by wheat plant. This indicates that this humic acid is in a good mature state than the other studied humic acids.

Keywords: humic acids, available nutrients, composts, wheat plant.

INTRODUCTION

Modern agriculture replaced organic materials with chemical fertilizers. This trend has been reversed in recent years and the desire to utilize organics and recycle organic matter using field application has increased. These amendments can improve soil physical structure by increasing water holding capacity or reducing soil bulk density. They can also improve soil chemical properties by increasing cation exchange capacity or buffering soil pH to provide more soil environments for plants under a wide range of soil conditions (Schnitzer, 1992).

Numerous publications since the early years of this century refer to humic substances as plant growth promoting factors. Relations of humic substances with plant growth have been critically reviewed by Chen and Aviad (1990) and Chen *et al.* (1994). In their review, they described growth promoting effects in cereals such as wheat, barley and corn. Stimulation of root growth and enhancement of root initiation have commonly been found.

Research by Lee and Bartlett (1976) indicated that application of humic acids to a sandy soil low in organic matter or to nutrient solutions improved plant growth compared with the control. Metwally *et al.* (1976) demonstrated that the addition of humic acids to Nile suspended matter amended with $CaCO_3$ increased Fe, Zn and Cu uptake by barley plant. El-Gala (1978) found that the addition of previously isolated and purified humic acids resulted in an increase of the amounts of Fe, Mn, Zn and Cu in soil solution. The increase in the amounts of water soluble forms of Fe, Mn, Zn and Cu was related to the ability of humic substances to react and form chelating compounds with these elements.

The objective of this investigation is to elucidate the effect of adding some humic acids extracted from different composts into different two soils on wheat plant.

MATERIALS AND METHODS

A pot experiment was carried out at the College of Food and Agricultural Sci., King Saud University. Two soil samples were collected from the surface layer (0-30 cm) to represent; 1) a highly calcareous loamy sand soil which was collected from Dirab area and 2) noncalcareous sandy soil, was collected from Qasseem region, Saudi Arabia. Some physical and chemical characteristics of the investigated soils are shown in Table 1. The soils were used to fill plastic pots that were 20 cm in diameter with a capacity of 4 kg soil.

Table (1): Physical and chemical properties of the investigated soils

Soil property	Non calcareous soil (S_1)	Calcareous soil(S_2)
Sand,%	92.00	86.72
Silt,%	6.75	2.00
Clay,%	1.25	11.28
Soil texture	Sandy	Loamy sand
$CaCO_3$,%	4.20	28.00
Organic matter,%	0.05	0.12
pH (soil paste)	7.40	7.43
Ec_e, dSm^{-1}	0.80	0.85
Available N, ppm	24.00	43.00
Available P, ppm	7.00	3.80
Available K, ppm	49.00	61.00
Available Fe, ppm	2.14	1.98
Available Mn, ppm	0.14	0.80
Available Zn, ppm	0.40	0.54
Available Cu, ppm	0.10	0.09

The humic acids were extracted and purified (Kononova, 1966) from four types of composts used in the Kingdom of Saudi Arábia, namely: a) animal compost (HA_1); b) plant animal compost (HA_2); c) plant compost (HA_3) and d) sludge compost (HA_4). Some chemical properties of the isolated humic acids are shown in Table 2. The humic acids were added at five rates equivalent to: 0, 50, 100, 150 and 200 kg ha^{-1}. Ten seeds of wheat (Triticum aestivum L. cv. Yacora rojo) were planted in each pot, and after 15 days of germination, seedlings were thinned to five plants. Soon after thinning, each pot received N, P, K fertilizers equivalent to 30% of the recommended dose for wheat plant. Nitrogen was added as urea, while P and K were applied as KH_2PO_4. The soil moisture content was always kept at the field-capacity.

Table (2): Chemical analysis of the investigated humic acids

HAs	(%)				(ppm)			
	C	H	N	O	Fe	Mn	Zn	Cu
HA_1	51.23	6.38	7.63	34.76	412	247	258	316
HA_2	50.55	4.45	4.90	40.10	490	214	248	215
HA_3	46.91	4.16	6.34	42.59	408	243	106	176
HA_4	53.68	5.40	5.65	35.27	680	195	110	188

The treatments were arranged in a complete randomized block design with three replicates. Plants were harvested after 112 days from planting, and total yield and yield components of both grain and straw were recorded. Samples of the grain yield were digested, and the nutrients content (N, P, K, Fe, Mn, Zn, and Cu) was determined according to the methods described by Chapman and Pratt (1961). Representative soil samples were taken from each pot after harvesting, air dried, and kept for analysis. Organic matter content in the studied soils was determined by Walkly and Black method as described by Hesse (1971). Available P, K, Fe, Mn, Zn, and Cu nutrients in soil were extracted by NH_4HCO_3-DTPA (AB-DTPA) solution according to the method described by Soltanpour and Schwab (1977). P was determined colrimetrically according to Jackson (1967). K was determined by a flame photometer (Jackson, 1967). The micronutrients (Fe, Mn, Zn and Cu) were determined by Inductively Coupled Plasma Spectrometer (ICP) (Optima 4300 DV).

Data were analyzed by using Statistical Analysis System-Analysis of Variance (SAS-ANOVA) (Statistical Analysis System Institute, 1982) with least significant difference (LSD) for mean separation.

RESULTS AND DISCUSSION

Available nutrients:

Data presented in Table 3 show that application of the different humic acids, significantly increased the available P and K as well as micronutrients (Fe, Mn, Zn and Cu). The values of available P and K and micronutrients (Fe, Mn, Zn and Cu) were higher for the humic acid which extracted from the animal compost (HA_1). This result may be due to the high content of mineral nutrients initially present in the HA_1, also this humic acid was in a good mature state which causes more availability for the nutrients in the soil (Taha and Modaihsh, 2003 and Modaihsh *et al.*, 2005).

Increasing the available form of Fe, Mn Zn and Cu in the soils is related to ability of humic acids to form chelating compounds with these elements in the soil. Purification of the humic acids used in this study did not remove the heavy metals bound by ligand exchange or specifically adsorbed (unavailable form to plant) (El-Agrodi *et al.*, 1989 and Mackowiak *et al.*, 2001).

It is worthy to note that, generally, the calcareous soil (S_2) (Table, 3) gave the lowest values of available nutrients in comparison with the noncalcareous soil (S_1). This result is related to the high content of $CaCO_3$ (28%) in the S_2 which fixed the available form to be unavailable form, whereas the noncalcareous one (S_1) gave the higher values of available nutrients because these nutrients are more soluble in this soil which has a low content of $CaCO_3$ (4.2%). The increase in available nutrients in this investigation due to applying the humic acids may be attributed to lowering soil pH value through yielding intermediate organic acids, as well as increasing the activity of soil organisms to liberate more nutrients from the unavailable reserves. These results are in a good accordance with the data reported by El-Sirafy *et al.* (2001).

Table (3): Available nutrients in the two studied soils as affected by humic acids (mg kg^{-1})

Treatments		P		K		Fe		Mn		Zn		Cu	
Has	Rates	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
HA_1	0	8.33	5.18	56.00	76.00	2.82	1.45	0.45	0.90	0.49	0.24	0.18	0.25
	50	7.96	3.72	60.00	77.00	2.51	1.54	0.46	0.84	0.34	0.23	0.21	0.26
	100	8.39	3.83	69.00	73.00	2.29	1.49	0.57	0.91	0.28	0.20	0.22	0.26
	150	9.72	3.06	46.00	64.67	2.53	1.52	0.50	0.88	0.35	0.20	0.28	0.24
	200	8.25	5.11	44.33	69.00	2.77	1.57	0.47	0.96	0.27	0.22	0.35	0.24
Mean		**8.53**	**4.18**	**55.07**	**71.93**	**2.58**	**1.51**	**0.49**	**0.90**	**0.35**	**0.22**	**0.25**	**0.25**
HA_2	0	8.00	3.25	49.00	70.00	2.12	1.54	0.38	0.73	0.33	0.20	0.20	0.22
	50	7.66	3.19	49.00	68.00	2.24	1.45	0.43	0.93	0.27	0.21	0.22	0.24
	100	8.00	2.34	43.00	69.00	2.85	1.40	0.46	0.76	0.35	0.20	0.21	0.23
	150	8.87	3.19	44.33	73.00	2.36	1.51	0.43	0.86	0.25	0.19	0.20	0.24
	200	8.50	3.01	47.00	73.00	2.61	1.47	0.43	0.82	0.24	0.21	0.20	0.23
Mean		**8.21**	**3.00**	**46.47**	**70.60**	**2.44**	**1.47**	**0.43**	**0.82**	**0.29**	**0.20**	**0.21**	**0.23**
HA_3	0	7.49	2.45	43.67	68.33	2.72	1.52	0.40	0.77	0.17	0.21	0.21	0.25
	50	8.10	2.49	47.00	72.00	2.22	1.33	0.42	0.67	0.22	0.20	0.20	0.23
	100	8.52	2.73	46.33	70.00	2.52	1.37	0.44	0.72	0.22	0.18	0.21	0.25
	150	8.16	2.32	46.00	67.00	2.28	1.27	0.49	0.70	0.19	0.19	0.23	0.24
	200	8.68	1.53	49.00	73.67	2.08	1.25	0.57	0.69	0.25	0.17	0.21	0.26
Mean		**8.19**	**2.30**	**46.40**	**70.20**	**2.36**	**1.35**	**0.46**	**0.71**	**0.21**	**0.19**	**0.21**	**0.25**
HA_4	0	7.63	3.15	49.67	66.67	2.02	1.05	0.42	0.60	0.24	0.17	0.21	0.21
	50	7.39	1.88	46.33	66.33	2.42	1.16	0.41	0.59	0.19	0.17	0.21	0.21
	100	7.08	1.86	46.33	67.33	2.28	1.24	0.43	0.64	0.20	0.17	0.25	0.21
	150	7.98	2.27	51.00	69.00	2.30	1.23	0.41	0.71	0.18	0.18	0.21	0.22
	200	7.22	3.24	51.00	70.00	2.37	1.31	0.42	0.78	0.24	0.20	0.22	0.22
Mean		**7.46**	**2.48**	**48.87**	**67.87**	**2.28**	**1.20**	**0.42**	**0.66**	**0.21**	**0.18**	**0.22**	**0.21**
LSD 5%	Soil	0.323		0.811		0.091		0.025		0.020		0.011	
	HAs	0.457		1.147		0.129		0.035		0.029		0.016	
	Rates	NS		1.282		NS		0.040		NS		NS	

As shown in Table 3, increasing the application rate of humic acids from 0 t 200 kg ha^{-1} does not significantly increase the available nutrients in the two studied soils except for K and Mn. The insignificant effect of increasing humic acids rates on the other available nutrients is attributed to its resistance to microbial degradation, so they cannot be considered as a source of nutrients especially in a short time. In addition to this, the humic acids used in this work have been washed by HCl acid and purified, so they did not contain cations available to plants. Similar results were reported by El-Agrodi *et al.* (1989).

Organic matter and wheat yield:

The influence of applying humic acids to the studied soils on organic matter content in soil and grain and straw yield of wheat plant is shown in Table 4. It appears from the data that addition of different humic acids increased significantly the organic matter content in the two studied soils after harvesting wheat plant. The highest values of organic matter in the two studied soils were observed due to adding the humic acid which extracted from the animal compost (HA_1), while the lowest values were obtained due to adding the humic acids extracted from sludge compost (HA_4). This result may be attributed to the high content of organic carbon in the humic acid extracted from animal compost (HA_1) and low carbon content in the humic acid extracted from sludge compost (HA_4), also the animal humic acid (HA_1) is in a mature state and was extracted from mature compost. Similar results were reported by Modaihsh *et al.* (2005).

Data in Table 4 reveal that increasing the application rate of humic acids from 0 to 200 kg ha^{-1} significantly increased the organic matter content in the two investigated soils, but there is no significant difference between the calcareous and the noncalcareous soils. These results are in agreement with the results reported by Taha *et al.* (1991).

Concerning the effect of added humic acids on the yield of wheat, data in Table 4 show a significant increase in the total yield, grain and straw yields of wheat crop at the different types of the humic acids. Wheat yield (grain, straw and total yields) due to humic acid extracted from animal compost (HA_1) are significantly higher than that the other studied humic acids. While, the lowest value of wheat yield was recorded due to applying humic acid extracted from sludge compost (HA_4). This result confirmed the results obtained about the effect of humic acids on the organic matter content as shown in Table 3. The obtained results may be attributed to the higher content of nutrients in the HA_1 than that in the other humic acids.

Khristeva and Luk'yanenko (1962) believed that humic materials enter the plant during early stages of growth and act as supplementary sources of polyphenols that serve as respiratory catalysts. In addition, Schnitzer and Khan (1972) suggested that humic substances exert two types of effects in relation to plants: a) indirect effects which involve humic acids acting as suppliers and regulators of plant nutrients similar to synthetic ion exchangers, and b) direct effects which occur when humic substances are taken by plant roots.

As shown in Table 4, the total yield and the grain yield of wheat plant under calcareous soil (S_2) were higher than the noncalcareous soil (S_1). This result may be attributed to the lower content of nutrients in the sandy soil (S_1) which does not hold enough irrigation water, moreover the texture of the calcareous soil (S_2) is sandy loam which hold water higher than the sandy soil, so the water holding capacity of this soil is increased.

Data illustrated in Table 4 show that there are significant differences in the yields of wheat crop (grain, straw and total yields) were obtained when the applied humic acids rates increased from 0 to 200 kg ha^{-1}. The limited effect of increasing the application rate of some humic acids on the yield of wheat in the present study and on the yield of a variety of crops has been reported by some workers. Kononova (1966) stated that small concentrations of humic acids, i.e., up to 60 ppm, enhanced root development and plant growth. On the other hand, Vaughan and Malcolm (1985) reported that stimulating effect of humic acids on plant growth was depending upon the concentration of humic acids in the medium. Taha *et al.* (1991) reported that concentration of 100 ppm humic acid produced the highest dry matter of wheat, barley and corn plants. Meanwhile, the concentration of 300 ppm humic acid produced the highest dry matter in broad bean. They concluded that the previous results could be attributed to the favourable effects of the tested treatments on plant growth, root development and nutrients uptake.

Table (4): Effect of humic acids on organic matter (%) and wheat yield (g/pot).

Treatments		O.M%		Total Y.		Grain		Straw	
HAs	Rates	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
HA_1	0	0.42	0.45	4.96	4.67	1.40	2.37	3.53	2.30
	50	0.53	0.46	4.54	5.53	1.63	2.63	3.27	2.90
	100	0.55	0.47	2.60	4.80	1.63	2.57	1.93	2.23
	150	0.62	0.49	4.73	5.20	1.87	2.50	3.33	2.70
	200	0.64	0.54	4.00	4.83	1.17	2.40	2.43	2.43
Mean		**0.55**	**0.48**	**4.17**	**5.01**	**1.54**	**2.49**	**2.90**	**2.51**
HA_2	0	0.29	0.28	4.04	4.90	1.47	2.33	2.57	2.57
	50	0.37	0.34	3.56	5.70	1.33	2.87	2.23	2.83
	100	0.45	0.42	4.30	4.37	1.60	2.17	2.70	2.20
	150	0.47	0.45	4.77	4.60	1.90	2.37	2.87	2.23
	200	0.55	0.53	3.37	4.90	1.30	2.33	2.07	2.57
Mean		**0.43**	**0.40**	**4.01**	**4.89**	**1.52**	**2.41**	**2.49**	**2.48**
HA_3	0	0.19	0.28	3.27	4.57	1.43	2.27	1.87	2.30
	50	0.26	0.34	3.63	5.50	1.27	2.77	2.00	2.73
	100	0.27	0.40	3.53	4.53	0.67	2.43	1.90	2.10
	150	0.35	0.41	4.40	4.96	1.40	2.63	2.53	2.33
	200	0.42	0.43	3.07	4.53	1.57	2.13	1.90	2.40
Mean		**0.30**	**0.37**	**3.58**	**4.82**	**1.27**	**2.45**	**2.04**	**2.37**
HA_4	0	0.32	0.31	2.77	4.46	1.30	2.37	1.47	2.10
	50	0.34	0.32	2.77	4.63	1.20	2.53	1.57	2.10
	100	0.36	0.34	3.03	4.46	1.13	2.33	1.90	2.13
	150	0.41	0.36	3.53	4.50	1.63	2.43	1:90	2.07
	200	0.43	0.38	3.13	4.67	1.30	2.47	1.83	2.20
Mean		**0.37**	**0.34**	**3.05**	**4.54**	**1.31**	**2.43**	**1.73**	**2.12**
LSD 5%	Soil	NS		0.183		0.079		NS	
	HAs	0.029		0.259		0.112		0.197	
	Rates	0.032		0.289		0.125		0.220	

Nutrients uptake of wheat plant:

As shown in Table 5, data reveal that applying the different humic acids to the studied soils significantly increased nitrogen, phosphorus and potassium uptake (mg/pot) as well as Fe, Zn and Cu uptake (ppm) by the grain of wheat plant. It is noticeable that the highest values of the nutrients uptake are due to adding humic acid extracted from animal compost (HA_1) which is parallel with the increase in grain yield as indicated in Table 3. It could be mentioned that no significant difference in Mn uptake was detected.

Table (5): Effect of humic acids on nutrients uptake of wheat plant under different soils

Treatments		N		P		K		Fe		Zn		Mn		Cu	
Has	Rates	mg/pot						mg kg^{-1}							
		S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
HA_1	0	17.59	49.55	5.42	7.27	6.10	9.61	52.20	125.43	15.83	36.33	5.63	18.80	5.40	8.13
	50	19.37	48.45	6.84	8.90	6.43	10.87	68.07	83.33	18.70	27.53	6.37	15.60	6.37	8.00
	100	21.06	28.79	7.65	8.74	8.51	11.58	44.27	236.43	18.83	27.20	4.77	15.73	7.10	50.53
	150	18.16	21.47	7.65	8.73	8.19	11.10	52.73	140.60	19.27	32.20	3.20	16.87	6.47	45.60
	200	17.24	18.49	4.69	7.89	5.86	10.23	67.73	120.47	19.53	32.87	7.80	16.33	6.67	48.27
Mean		**18.68**	**33.35**	**6.45**	**8.31**	**7.02**	**10.68**	**57.00**	**141.25**	**18.43**	**31.23**	**5.55**	**16.67**	**6.40**	**32.15**
HA_2	0	12.60	16.29	4.84	7.84	5.85	11.20	35.60	71.97	14.83	31.67	2.00	16.27	1.53	37.80
	50	14.08	17.41	5.14	8.31	5.35	13.63	35.40	65.27	12.13	27.00	2.00	18.13	0.30	57.53
	100	12.22	15.43	6.77	6.65	2.92	8.53	35.73	53.60	11.67	26.00	5.60	15.67	2.53	19.47
	150	13.19	16.07	6.01	7.16	5.67	9.16	36.33	95.87	10.53	26.60	4.20	16.27	6.27	13.07
	200	9.74	19.60	4.30	7.48	6.84	9.31	45.27	61.20	12.13	29.53	3.67	16.60	2.60	10.83
Mean		**12.37**	**16.96**	**5.41**	**7.49**	**5.33**	**10.37**	**37.67**	**69.58**	**12.26**	**28.16**	**3.49**	**16.59**	**2.65**	**27.74**
HA_3	0	11.50	17.29	5.29	6.86	6.11	9.41	25.40	86.30	14.33	25.67	7.07	16.27	0.73	12.20
	50	13.37	21.28	5.59	8.88	7.88	11.22	26.80	57.80	13.93	22.53	2.67	18.07	1.53	6.13
	100	13.83	17.94	3.62	8.07	7.65	9.10	28.13	53.57	14.33	24.33	1.70	13.27	1.63	5.80
	150	13.97	19.59	4.93	9.16	7.71	11.42	30.87	45.93	15.60	28.00	2.80	16.27	6.33	6.73
	200	8.99	14.44	5.48	7.45	4.68	9.00	22.13	51.27	16.40	26.93	2.00	15.60	8.47	6.10
Mean		**12.33**	**18.11**	**4.98**	**8.08**	**6.81**	**10.03**	**26.67**	**58.97**	**14.92**	**25.49**	**3.25**	**15.90**	**3.74**	**7.39**
HA_4	0	10.29	17.67	5.35	7.74	5.74	9.79	23.40	25.50	14.40	29.27	6.57	14.73	8.30	5.93
	50	9.86	18.23	5.74	8.70	5.64	10.97	27.13	44.83	15.13	25.40	5.73	13.73	3.90	6.20
	100	8.97	17.67	6.31	8.33	5.33	9.96	27.33	44.73	21.80	28.60	6.07	17.87	0.53	6.27
	150	12.51	17.59	5.97	7.78	7.65	10.37	29.60	44.83	13.60	24.53	2.43	14.87	2.63	7.47
	200	10.37	17.51	5.25	7.73	6.10	10.93	27.87	35.47	14.47	26.27	6.33	13.73	1.13	6.13
Mean		**10.40**	**17.73**	**5.72**	**8.06**	**6.09**	**10.40**	**27.07**	**39.07**	**15.88**	**26.81**	**5.43**	**14.99**	**3.30**	**6.40**
LSD 5%	Soil	1.829		0.354		0.405		2.699		1.010		0.839		1.415	
	HAs	1.546		0.500		0.573		3.816		1.428		NS		2.001	
	Rates	1.729		0.559		0.640		4.267		1.597		NS		2.238	

Regarding the effect of adding humic acids into the studied soils, it is obvious that the N, P, K, Fe, Mn, Zn and Cu uptake was higher in the calcareous soil (S_2). This result is attributed to increasing the grain yield in this soil (Table 4). These results are in agreement with the data reported by Metwally (1976). Dekock (1955) reported that humic substances prevented immobilization of Fe and P and facilitated their translocation from roots to shoots. Stevenson (1982) indicated that humic substances have stimulating effects on nutrients uptake and growth rate.

On the other hand, data presented in Table 5 show that all nutrients uptake increased significantly as the application rate of the humic acids increased except for Mn uptake. Similar results were reported by Modaihsh *et al.* (2005). Lee and Bartlett (1976) observed that nutrients uptake of corn plants increased with the higher levels of humic acids. Moreover, Taha *et al.* (1991) concluded that increasing rate of humic acids leads to an increment increase in plant uptake of nutrients and at the end was reflected on plant growth and its yield.

Thus, it can be concluded that the addition of different humic acids to a soil rich in $CaCO_3$ decreased the available nutrients in compared to the noncalcareous one. Increasing the rates of applied humic acids resulted in an insignificant difference in the available nutrients. On the other hand, applying humic acids increased organic matter content in the two studied soils as well as grain and straw yields of wheat plant in addition to increase the nutrients uptake. Application of humic acid extracted from animal compost resulted in higher values of available nutrients, organic matter, grain and straw as well as nutrients uptake. This humic acid is in a good mature state than the other humic acids.

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تأثير بعض الأحماض الدبالية على نبات القمح النامى فى ترب مختلفة

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أقيمت تجربة أصص لدراسة تأثير إضافة أربعة أنواع من الأحماض الدبالية المستخلصة من أنواع مختلفة من الأسمدة العضوية الصناعية (الكومبوست) على إنتاجية محصول القمح النامى فى تربتين أحدهما تحتوى على نسبة عالية من كربونات الكالسيوم(٢٨%) والأخرى بها نسبة منخفضة من كربونات الكالسيوم (٤,٢%). وقد أضيفت الأحماض الدبالية بخمس معدلات هى: صفر ، ٥٠ ، ١٠٠، ١٥٠ و ٢٠٠ كجم/ هكتار ، وأضيفت الأسمدة الكيماوية (نيتروجين- فوسفور و بوتاسوم) بمعدل ٣٠% من الكميات الموصى بها فى تسميد القمح.

أوضحت النتائج أن كميات العناصر الميسرة (فوسفور، بوتاسيوم، حديد، منجنيز، زنك ونحاس) فى التربة الغير جيرية كانت أعلى من كميتها فى التربة الجيرية، بينما أدت زيادة معدلات إضافة الأحماض الدبالية إلى زيادة محتوى الترب تحت الدراسة من المادة العضوية، كذلك أدت إلى زيادة إنتاجية محصول القمح من الحبوب والقش وانعكس ذلك على زيادة الكمية الممتصة من عناصر النيتروجين والفوسفور والبوتاسوم وكذلك من عناصر الحديد والمنجنيز والزنك والنحاس بواسطة نبات القمح.

أظهرت النتائج أيضا أن إضافة حمض الهيوميك المستخلص من السماد العضوى الصناعى الناتج من المخلفات الحيوانية أدت إلى الحصول على أعلى النتائج بالنسبة لكل من العناصر الميسرة والمادة العضوية فى التربة ومحصول القمح وكذلك الكمية الممتصة من العناصر. هذا يدل على أن هذا الحامض الدبالى فى حالة جيدة من التدبل والنضج مقارنة بالأحماض الدبالية الأخرى.