UTILIZATION OF SOME ORGANIC POLYMERS AND HUMIC ACIDS FOR IMPROVING A SANDY SOIL PRODUCTIVITY OF PEANUT AND THEIR RESIDUAL EFFECTS ON THE NEXT CROP OF FABA BEAN

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ABSTRACT:

A field experiment was conducted on a cropping sequence pattern of two legume crops to avoid the residual effect of the grown crop at the next season, i.e., peanut as summer crop (*Arachis hypogaea,* Giza 5) followed by faba bean as a winter one (*Vicia faba,* Giza 2) grown on sandy soils under sprinkler irrigation system at El Ismailia Agricultural Research Station during the agricultural growing season of 2002/2003. The current study aims to identify the direct and residual beneficial effects of applying some organic polymers (carboxy methyl cellulose-CMC and polyvinylacetate-PVAc) and humic acids-(HA) on some hydrophysical and fertility status of sandy soil (bulk density, total porosity, hydraulic conductivity, moisture constants and nutrients retained) at elongation stage of vegetative growth as well as vegetative growth, yield and its attributes of the studied two crops, i.e., peanut (seed & foliage yields, harvest index, weight of 100 seed, seed oil %, protein % and uptake nutrient contents of N, P, K, Fe, Mn and Zn) and faba bean (plant height, No. of branches or leaves/plan, dry matter of stem or leaves, seed and foliage yields, harvest index, 100 seed weight, protein and uptake nutrient contents). The applied rates of organic polymers were 2 % w/w as individual or combined treatments with humic acid (solid K-humate at a rate of 50 mg kg^{-1}), then were thoroughly mixed with the 15 cm soil surface.

The results obtained indicated that the applied organic polymers and humic acid as either individual or in combined treatments (HA+PVAc and HA+CMC) showed significant and positive increases in both soil characteristics and the grown peanut parameters under investigation, with a significant superiority for the combined treatments. The beneficial influence was extended in a parallel trend to the next winter crop of faba bean as a residual effect, but with useful-less for all the previous studied soil characteristics and plant parameters.

It is evident that the applied organic amendments, either as individual or together treatments, were achieved many of the beneficial effects on soil hydrophysical and fertility status as well as plant parameters, since humic acid acted like plant growth hormones. In addition, organic polymers (carboxymethylcellulose and polyvinylacetate) partially capable to retain water and nutrients for growing plants, where it would act as complexing agents, this minimizes the loss of nutrients by leaching. Thus, these chelating gents, through OH and COOH as active groups for micronutrients and water molecules, are considered as a

storehouse with easily mobile or available to uptake by plant roots, and in turn reflected positively on development of yield and its attributes for both studied peanut and faba bean crops.

Key words: Humic acids, organic polymers, peanut, faba bean and sandy soil.

INTRODUCTION

The hydrophysical and fertility status of sandy soils, which represent a pronounced area of the newly reclaimed desert areas, could be extremely low mainly due to the dominance of sand fraction that is most practically capable to retain neither water nor nutrients for the growing plants. In addition, the amounts of organic matter available to Egyptian farmers are decreasing with increasing tendency towards the mechanization of agriculture in the country **(Abdel-Ghaffar, 1982 and Metwally and Khamis, 1998)**. So, the use of organic soil conditioners, whether natural or synthetic, is of importance through improving the hydrophysical properties and nutritional status in such soils, where the amendments lead to reduce the losses of applied irrigation water and nutrients via leaching as well as to maximize water and fertilizers use efficiency **(Abd El-Hady *et al*., 1997 and Abd El-Hady and Hefny, 2001)**.

De Boodt (1988) found that added synthetic polymers as soil conditioners led to improve soil hydrophsical properties and its productivity. It is true since mixing sand medium with some organic materials (composts) and super absorbent materials (hydrogels) will gain the beneficial effects of both types of soil conditioners. The resultant, obtained media may offer more favourable conditions for growing plants. **El-Naggar *et al*. (1988)** indicated that increasing the rate of viterra polmta-gel from 0.15 to 0.3 % increased the amount of N, P, K and Ca in *Vicia faba* seedling grown on sandy soil. **Khadr *et al*. (1988)** found that the total amounts of N and P increased by increasing the hydrogel up to 2.0 g kg^{-1} sand. **Abdel-Mottaleb *et al.* (1989)** found that the conditioning of sandy soils using bitumen emulsion followed by PVAc, generally decreased the bulk density values via increased of soil total porosity % and available water content. **Kotb (1994)** mentioned that conditioning the sandy soil with hydrogel increased the contents of N, P and K in plants, however, a trend almost similar to that of their dry weight.

Peanut is one of widely distributed crop in sandy soils of Egypt. Also, peanut can be grown as a supplementary crop to decreases the gap between the import and the local production of oil in Egypt. At the same time, Faba bean takes the first place among the most important food legumes in Egypt. It ows its importance chiefly to its high protein content, reaching 24% in seeds. It is also containing high concentration of P and Ca. In addition, it is relatively cheap to produce and it promises high return when properly grown. **Salib (2002)** reported that, in general, peanut yield and its components responded markedly to humic acids as an organic amendment used either individually or together others. This is due to their positive effect on nutrients availability in soil and their uptake by the grown plants. **Abo El Soud *et al.* (2004)** found that the organic fertilization led to a significant increase for each of shoot dry weight, straw and seed yields of faba bean plants grown on a newly reclaimed sandy soil.

The current study aims to identify the beneficial effects of some organic polymers (carboxy methyl cellulose and polyvinylacetate) and humic acids for improving a sandy soil productivity of peanut, with special reference to their residual effects on the next crop of faba bean.

MATERIALS AND METHODS:

A field experiment was conducted on a cropping sequence pattern of two legume crops to avoid the residual effect of the grown crop at the next season, i.e., peanut as summer crop (*Arachis hypogaea*, Giza 5) followed by faba bean as a winter one (*Vicia faba*, Giza 2) grown on sandy soils under sprinkler irrigation system. The current study aims to identify the direct and residual beneficial effects of applying some organic polymers (carboxy methyl cellulose-CMC and polyvinylacetate-PVAc) and humic acids-HA on some hydrophysical and fertility status of sandy soil well as vegetative growth, yield and its attributes of the studied two crops. Some hydrophysical, chemical and fertility status of the studied sandy soil are illustrated in Table (1).

Table (1): Some hydrophysical, chemical and fertility status of the experimental soil.

Soil characteristics	Value	Soil characteristics	Value
Particle size distribution %:		*Soluble cations (meq/L):*	
Sand	89.4	Ca^{2+}	0.83
Silt	7.6	Mg^{2+}	0.60
Clay	3.0	Na^{+}	0.90
Textural class	Sand	K^{+}	0.11
Soil chemical properties:		*Soluble anions (meq/L):*	
pH (1:2.5 soil suspension)	7.73	CO_3^{2-}	0.00
$CaCO_3$ %	1.15	HCO_3^{-}	1.40
Organic matter %	0.14	Cl^{-}	0.65
ECe (dS/m, soil paste extract)	0.24	SO_4^{2-}	0.39
Some physical properties:		*Available macro & micronutrients:*	
Soil bulk density (g/cm^3)	1.78	N (mg/kg)	15.05
Total porosity %	39.75	P	4.85
Hydraulic conductivity (cm/h)	13.46	K	60.75
Soil moisture at field capacity%	12.39	Fe	5.30
Soil moisture at wilting point%	5.18	Mn	0.92
Soil moisture at available water%	7.21	Zn	0.48

To achieve this target, a field experiment was carried out on a newly reclaimed sandy soil at El Ismailia Agricultural Research Station during the agricultural growing season of 2002/2003. It was started with peanut at summer season, followed by faba bean at winter one of the agricultural growing season of 2002/2003. The applied rates of organic polymers were 2 % w/w as individual or combined with humic acid (solid K-humate at a rate of 50 mg kg^{-1}), then were thoroughly mixed with the top 15 cm soil. Each experiment was laid out with five main treatments (HA, CMC, PAVc, HA+CMC and HA+PAVc that were applied in the fixed plots, with an area of 10.5 m^2 (3.0 x 3.5 m^2) for each one, with three replicates, arranged into a complete randomized block design.

The IR (infra red) bands of the used humic acid were identified according to the standard method described by **Kononova (1966)** to identify the active groups **(Stevenson, 1982 and 1994)**, as shown in Table (2). It is noteworthy to mention that the active OH and COOH represent pronounced values, so as humic acid is considered as a best metabolic effect. In addition, **Nardi *et al*. (1999)** suggested that humic fractions exhibited an auxin like activity.

Table (2): Chemical composition of the used humic acid.

a) Elemental composition (%)							
%					Atomic ratios		
C	H	N	O	Ash	C/N	C/H	C/O
53.22	5.71	2.90	38.17	2.48	18.35	9.32	1.39

b) Total acidity and functional groups (meq/100 mg)				
Total acidity	COOH	Total OH	Phenolic-OH	Alcoholic-OH
797.5	479.1	349.2	318.4	30.8

All peanut plots received 40 kg/fed N as ammonium sulphate (20.6 % N), added as basal doses in two equal ones (one and two months after planting). P was added with a rate of 31 kg fed^{-1} P_2O_5 as superphosphate (15.5 %P_2O_5), while K was added with a rate of 50 kg fed^{-1} K_2O as potassium sulphate (48 % K_2O) during the preparation of soil for cultivation. Faba bean plants received the mineral fertilizers at rates of 15 kg N fed^{-1} as ammonium sulfate (20.6 % N), 30 kg P_2O_5 fed^{-1} superphosphate (15.5 % P_2O_5) and 24 kg^{-1}fed K_2O as potassium sulphate. Nitrogen fertilizer was added 25 days after planting, whereas phosphours and potassium fertilizers were added before planting.

Some physical, chemical and fertility properties of the investigated soil (bulk density, total porosity, hydraulic conductivity, moisture constants and nutrients retained) at elongation stage of vegetative growth were determined according to the standard methods as described by **Piper, (1950) Richerds, (1954), Jackson, (1973) and Page *et al.* (1982)**. Available N, P and K were extracted by 1% K_2SO_4, 0.5 M solution sodium bicarbonate and 1 N ammonium acetate respectively, and were determined according to **Jackson (1973)**. Available micronutrients of Fe, Mn and Zn were extracted by DTPA **(Lindsay and Norvell, 1978)** and determined using Atomic Absorption Spectrophotometer.

Yield and its attributes of peanut (seed & foliage yields, harvest index, weight of 100 seed, seed oil, protein and uptake nutrient contents of N, P, K, Fe, Mn and Zn) and faba bean (plant height, No. of branches or leaves/plan, dry matter of stem or leaves, seed and foliage yields, harvest index, 100 seed weight, protein % and uptake nutrient contents) were determined.

From each plot, the chosen samples of both seeds and foliage were dried, ground and wet digested using H_2SO_4-$HClO_4$ acid mixture. In the digested product, N was determined with a micro-kjeldahl **(Chapman and Pratt, 1961)**. Phosphorus was determined colour-metrically, according to **Watanabe and Olsen (1965)**. Iron, manganese and zinc were determined using an Atomic Absorption Spectrophotometer. Crud protein was calculated by multiplying total N-content by 6.25 **(Deyoe and Shellenberger, 1965)**. Oil content for peanut seeds was determined according to **Bligh and Dyer (1959)**. All collected data were statistically analyzed according to **Gomez and Gomez (1984).**

RESULTS AND DISCUSSION:

The current work may be helpful for identifying the best soil agro-management practices of some newly reclaimed soils for maximizing their productivity, especially for soils have no partially capable to retain neither water nor nutrients for growing plants. In addition, these soils are poor not only in the nutrient-bearing minerals, but also in organic matter, which are a storehouse for the essential plant nutrients, in turn the productivity of different crops tends to decrease markedly **(Metwally and Khamis, 1998)**.

I- *Effect of the applied organic amendments on soil hydrophysical and fertility status:*

The identified changes in the studied hydrophysical properties of sandy soil under consideration as related to the application of organic polymers and humic acid during the summer season and their residual effects in the next winter season are presented in Table (3).

Table (3): Different changes in soil hydrophysical and fertility status at the elongation stage of vegetative growth as related to the influence of the applied organic amendments during both summer and winter seasons.

Soil character*	Control treatment	Individual treatments			Combined treatments		LSD at 0.05
		HA	CMC	PAVc	HA+CMC	HA+PAVc	
Peanut as summer season							
BD	1.76	1.69	158	1.55	1.46	1.42	0.25
TP	39.82	42.03	44.65	45.23	48.75	49.05	1.04
HC	16.75	15.02	13.56	12.64	10.70	9.21	1.22
FC	12.51	13.75	15.01	15.73	18.65	19.43	1.00
WP	4.66	5.10	5.99	6.08	7.08	7.11	0.92
AW	7.85	8.65	9.02	9.65	11.57	12.32	2.81
N*	16.50	37.93	23.35	24.90	45.86	48.15	7.31
P	4.95	6.24	5.62	5.75	7.53	7.89	1.21
K	63.40	84.05	75.90	76.84	99.68	102.25	8.93
Fe	5.38	7.82	6.54	6.67	.9.95	10.57	2.31
Mn	0.90	1.43	1.15	1.19	1.87	1.93	0.52
Zn	0.49	0.76	0.59	0.61	0.96	1.02	0.33
Faba bean as winter season							
BD	1.74	1.71	1.66	1.64	1.60	1.57	0.43
TP	40.13	40.98	42.30	43.15	44.79	45.03	1.32
HC	16.09	15.25	14.62	14.03	13.05	11.71	1.11
FC	12.98	13.60	14.31	14.70	16.21	16.86	1.08
WP	5.06	5.21	5.69	5.75	5.81	5.92	0.53
AW	7.92	8.35	8.62	8.95	10.40	10.94	0.84
N**	16.82	28.42	20.35	21.71	31.02	33.70	6.77
P	5.02	5.27	5.50	5.61	6.50	6.92	0.32
K	67.50	76.15	81.48	83.01	95.11	96.37	7.73
Fe	5.42	6.67	5.84	5.95	7.79	8.05	1.78
Mn	0.97	1.52	1.09	1.13	1.49	1.58	0.67
Zn	0.51	0.65	0.57	0.60	0.75	0.81	0.51

*BD=Soil bulk density (g/cm^3), TP=Total porosity %, HC=Hydraulic conductivity (cm/h), FC=Soil moisture at field capacity%, WP=Soil moisture at wilting point% and AW=Soil moisture at available range%   ** Nutrients as mg/kg soil

In general, the studied soil characteristics responded markedly to all the tested treatments under peanut cultivation during the summer season at either added individually or together more than that observed for faba bean. Data also indicated that the individual and combined treatments showed a positive effect for improving the soil characteristics, i.e., the values of bulk density and hydraulic conductivity were decreased, whereas total porosity and retained moisture at field capacity, wilting point and available range as well as available nutrient contents

(N, P, K, Fe, Mn and Zn) increased with increasing the applied organic polymers and humic acid rates.

a. Soil bulk density and total porosity:

The results obtained in Table (3) showed also clearly that the applied organic polymers and humic acid as individual or combined treatments play a dual positive role, i.e., reducing soil bulk density vs increasing total soil porosity. Thus, the promotive effect of organic application on the soil porosity in the studied sandy soil may be due to the values of soil bulk density behaved the opposite trend with those obtained from total porosity. In general, this increase may be related to the increase of storage pores in the studied sandy soil, which can be regarded as an index of an improved soil structure. Moreover, a thin coat of translocated humic acid as organic material partially covered the walls interconnected vughs **(Brewer, 1964)**, which are usually the most common pores in this soil.

b. Hydraulic conductivity and soil moisture constants:

The improvement or the pronounced decrease in hydraulic conductivity of the studied sandy soil may be attributed to the creation of micro pores, and the dominance of meso and micro pores on the expose other pore sizes. These results are agreement with those of **El-Fayoumy and Ramadan (2002)**. Concerning the magnitudes of the changes in available water range, field capacity and wilting point at different applied organic materials and their rates, data showed that, in general, the soils treated with organic polymers possess relatively high values as compared to those amended with humic acid. This is due to the fact that organic polymers attain a pronounced high content of active organic compounds that enhancing the water molecules to be chelated. Thus, the applied organic polymers were surpassed humic acid for improving the previous soil hydophysical properties. This hold was true, since the active OH and COOH represent pronounced values and have been found to be a profound effect on not only the biological activity, but also on and soil structure **(Stevenson, 1982 and 1994 and El Fakharani, 1999)**.

Also, the applied organic materials produced polymers such as polysaccharides and polyuorinides that are capable for binding soil particles or aggregates **(El Maghraby, 1997)**. In addition, along with that the humus products from microbial decomposition of organic polymers of CMC and PAVc can absorb more than six times of its own weight water, thereby increases the soil moisture retention **(Tester, 1990). Tayel *et al*., (2001)** stated that the increase in water retained in sandy soil treated with CMC , PAVc may be due to one or more of the following reasons, a) decrease in soil bulk density and the increase in soil total porosity, b) the modification of soil structure and consequently its pore size distribution, c) the higher capacity of both CMC and PAVc for water retention in comparison to sand particles, and the rise in soil hydraulic resistively and the drop in soil hydraulic conductivity accompanying soil structure modification.

c. Soil fertility status as expressed by nutrients availability:

Data illustrated in Table (3) revealed that humic acid as individual treatment or combined with organic polymers was surpassed the applied organic polymers only for enhancing the availability of essential plant nutrients (N, P, K, Fe, Mn and Zn). This is true, since humic acid partially capable to retain nutrients for growing plants, where it would act as complexing agents. This minimizes the loss of nutrients by leaching **(Cheng *et al.,* 1998)**. Therefore, these chelating gents, through active groups for micronutrients, are considered as a storehouse with easily mobile or available to uptake by plant roots, and in turn reflected positively on development of yield and its attributes for both studied crops.

It is worthy to mention that the positive effect of organic polymers and humic acid together, may be due to these organic amendments enhanced crop production and fertilizer uptake by plants through its improvement of hydrophysical properties and thus increased soil ability to supply plants with their requirements of water and air along the growing season **(Poganiac, 1972)**. The same trend was observed for the next crop (faba bean) in the winter season as residual effects with useful-less for the studied different soil hydrophysical properties and fertility status.

In general, the beneficial effects of the applied organic materials on the studied different soil hydrophysical properties under both cultivated crops could be arranged in the following order:

PAVc+HA > CMC+HA > PAVc > CMC > HA

While, the beneficial effects of the applied organic materials on soil fertility (available nutrient contents) under both cultivated crops could be arranged in the following order:

PAVc+HA > CMC+HA > HA > PAVc > CMC

II- Effect of the applied treatments on crop yield and its components:

a. Seed and foliage or straw yields:

Results in Table (4) indicated the effect of applied individual and combined treatments (HA, CMC, PVAc, HA+CMC and HA+PVAc) on peanut seed and foliage yields. Data obtained showed a markedly increased in each of seed and foliage yields reached 67.11 49.64, 53.36, 76.38 and 83.25% for seed vs 55.11, 49.40, 54.36, 65.20 and 68.84% for foliage over the control treatment, respectively.

In addition, the residual effects of the applied organic amendments show the same trend as in the first crop. The corresponding values of increases in faba bean as a next crop were 29.18, 20.97, 22.82, 49.50 and 53.19% for seed vs 32.31, 13.55, 15.41, 44.08 and 46.15% for straw, respectively. It is evident that the combined treatments showed superior increased as well as HA as an individual treatment, followed by PAVc and CMC either in the cases of the first crop or the next one. It is worthy to mention that application of humic acid in combination with both CMC and PVAc, enhanced the role of both CMC and PAVc as organic polymers for increasing seed and foliage or straw yields of either peanut or bean plants, where the treatment of HA+PVAc showed the highest yields, followed by HA+CMC and HA solely added. These results could be explained according to the findings of **MacCarthy *et al.* (1990)** who reported that the beneficial effect of HA on plant growth related to its role, since it acts like plant growth hormones. Also, **Cheng *et al.*, (1998)** stated that humic acid decreased the loss of soil moisture, enhanced the water retention, increased the ability rate of leaves for photosynthetic process, increased the grain filling intensity, enhanced the drought resistance of seed and increased its hundred weight. In addition, the beneficial effect of humic acid not only due to the biological activity and soil structure, but also on the plant itself. This is due to their positive effect on the increment in plant nutrient and their availability to the growing plants **(El Fakharani, 1999)**.

Table (4): Effect of the applied organic polymers and humic acid treatments on peanut and faba bean yields and their attributes.

Treatment	Seed yield (kg fed^{-1})	Foliage yield (kg fed^{-1})	Weight of 100 seed (g)	Harvest index	Protein %		Seed oil content %
					Seed	Foliage	
Peanut							
Cont.	830	1595	42.92	37.56	11.44	7.25	30.07
HA	1387	2474	67.38	44.60	19.13	11.50	38.36
CMC	1242	2383	61.55	42.84	16.06	10.44	35.75
PVAc	1275	2462	63.93	43.22	17.19	10.88	36.03
CMC+HA	1494	2635	72.57	46.90	21.56	12.56	41.92
PVAc+HA	1521	2693	75.90	47.21	22.04	13.31	42.10
LSD at 0.05	227	314	9.05	1.03	3.20	2.81	3.60
Faba bean							
Treatment	Seed yield (kg fed^{-1})	Straw yield (kg fed^{-1})	Weight of 100 seed (g)	Harvest index	Protein %		
					Seed	Straw	
Cont.	596	1402	40.75	39.45	12.67	2.95	
HA	770	1855	49.29	40.27	19.62	4.49	
CMC	721	1592	46.45	43.94	17.37	3.72	
PVAc	732	1618	47.60	44.62	17.81	4.05	
CMC+HA	891	2020	53.96	45.09	22.75	4.89	
PVAc+HA	913	2049	54.30	45.86	23.04	5.02	
LSD at 0.05	73	114	1.62	1.03	8.21	2.41	

b. Weight of 100 seed:

Data presented in Table (4) indicated that the weight of 100 seed for the grown peanut and the next crop of bean was positively affected by the different applied treatments of HA, CMC and PVAc as individual or combined ones (HA+CMC and HA+PVAc). The relative increase in 100 seed weight of peanut reached 56.99, 43.40, 48.95, 69.08 and 76.84% over the control treatment, respectively. As for the residual effect on the next crop of bean, data obtained revealed that it was useful-less where the corresponding values were relatively lower and reached 20.96, 13.99, 16.81, 32.42 and 33.25%, respectively. These results were true for both studied crops of peanut as summer crop and faba bean as winter one, and are confirmed as a residual effect of the organic polymers application by **Askar *et al*. (1989)** who reported that the residual effect of the added PAVc resulted in an increased in structure coefficient, consequently enhanced crop production through encouraging nutrients uptake by plants. These benefits are more related to the improvement of soil hydrophysical properties that is increased soil ability to supply plants with their requirements of water and air along the growing season **(Poganiac, 1972)**.

c. Harvest index:

Values of the harvest index of peanut, Table (4), showed that the applied treatments of HA, CMC & PVAc as individual or combined (HA+CMC and HA+PVAc) exhibited a significantly response, with superiority for the combined ones. The aforementioned applied treatments were significantly increased the harvest index, but with insignificant differences among them. On the other hand, data obtained showed that neither the individual treatments nor the combined ones had significant effect on harvest index of faba bean.

d. Seed-foliage or straw protein and peanut oil content:

Data of protein content as affected by the applied humic acid and organic polymers as well as their combinations are illustrated in Table (4). The protein contents in peanut seed and foliage as affected by the applied treatments (HA, CMC, PVAc, HA+CMC and HA+PVAc) showed positive and significantly increased. In general, it obvious that the beneficial effects of HA+PVAc and HA+CMC as combined treatments followed by HA as individual treatment were surpassed the other tested ones (CMC and PVAc as individual treatments). The corresponding relative increases were 67.22, 40.38, 50.26, 88.46 and 92.65% for peanut seed vs 58.62, 44.00, 50.07, 73.24 and 83.59 % for foliage over the control treatment, respectively. The corresponding increases for protein in faba bean were 54.85, 37.09, 40.57, 79.56 and 81.85 % for seed vs 52.20, 26.10, 37.29, 65.76 and 70.19% for straw, respectively. It is noticed that the beneficial effect of humic acid was cleared when added solely or in combination with CMC and PAVc, as compared to the latter individually. In addition, the residual effects of the applied organic amendments on protein contents in both faba bean yields (seed and foliage) act like their direct effects on peanut protein contents with useful-less.

Regarding oil content, data in Table (4) revealed that the magnitude of the increases for the treatments of HA, CMC, PVAc, HA+CMC and HA+PVAc were 27.57, 18.89, 19.82, 39.41 and 40.01% over the control treatment, respectively. It is evident that seed oil content as a percentage was progressively increased (39.41-400.1 % over the control), when peanut plants treated with HA-combined treatments (HA+CMC and Ha+PVAc). This may be due to the effect of HA for enhancing the biosynthesis of seed oil of peanut plants.

e. Faba bean vegetative growth parameters as affected by the applied treatments:

The plant height, number of both branches and leaves per plant as well as dry matter of stems, leaves and whole plant were used as criteria to express the vegetative growth of faba bean plants at 70 days age. Data illustrated in Table (5) revealed that the aforementioned growth criteria were significantly affected by the different applied treatments. The combined treatment of HA+PVAc showed the highest increment as compared to the other ones, whereas the individual treatment of CMC showed the lowest increase over the control treatment. Likewise, HA gave values higher than those obtained with the treatments of CMC and PVAc.

The response of faba bean plants to HA may be due to the important role of this organic material, since it acts like plant growth hormones regulation and gibberellin like activity. This is suggested that humic fractions exhibited an auxin like activity, exhibiting higher amounts of phenolic and a considerable amount of carboxyl that showed the best metabolic effect. **Mackowiak (2001)** studied the effect of humic acid on plant growth and nutrients uptake, and pointed out that humic acid improved Fe-bioavailability by complexing $\approx 10^6$ M Fe, which prevented early Fe deficiency **(Nardi *et al.*, 1999)**. In addition, it encourages the plant to convert light energy to metabolities, and consequently, to increase the corresponding values of dry matter yield of faba bean organs **(Waly, 1996)**.

Table (5): Effect of the applied organic amendments on vegetative growth characters/plant of the grown faba bean.

Treatment	Height (cm)	No. of branches	No. of leaves	Dry matter (g/plant)		
				Stems	Leaves	W. plant
Cont.	32.45	2.48	5.73	2.84	1.76	4.60
HA	39.63	3.15	9.85	4.16	2.97	7.13
CMC	34.91	2.65	7.92	3.65	2.45	6.10
PVAc	36.17	2.71	8.14	3.70	2.53	6.23
CMC+HA	42.76	3.58	10.9	4.42	3.47	7.89
PVAc+HA	43.22	3.74	11.2	4.55	3.56	8.11
LSD at 0.05	2.31	0.84	3.50	1.91	0.95	2.70

f. Nutritional status as affected by the applied treatments:

The N, P and K uptake by both seed and foliage or straw of peanut and faba bean as affected by different applied organic amendments are shown in Table (6). It is noticed a significantly and positive response to applied treatments; the highest increases were strictly associated with the applied HA in combination with PVAc, since N content as kg/fed raised over the control treatment in peanut seed-foliage with 3.7-3.0 vs 2.7-2.5 times for seed-straw of the next crop (faba bean). The corresponding values of P and K were 3.7-3.9 vs 3.0 2.9 and 4.9-2.6 vs 2.9-2.3 times, respectively. Also, data revealed that the N, P and K uptake by peanut exhibited pronounced increases as a result of the direct effects of the applied treatments as compared to their residual effects on faba bean. These beneficial effects are more attributed to the improvement status of soil-water regime of studied sandy soil, consequently increasing nutrients availability for plants **(Wanas, 1996). Moreover, Kachinsk and Mosolova, (1976)** reported that the applied organic polymers contain nitrogen and potassium in their molecules, and found to be available for plant utilization. So, it could be arranged the applied treatments according their positive effects into the descending order of:

HA+PVAc > HA+CMC > HA > PVAc > CMC.

As for Fe, Mn and Zn uptake by both peanut seed and foliage, data in Table (6) showed the applied HA stimulate CMC and PVAc towards increasing micronutrients uptake, since progressive increases found to be and reached their maximum values at the combined treatment HA+PVAc. The values of Fe, Mn and Zn as kg/fed raised over the control treatment in peanut seed-foliage with 3.4-2.8, 3.1-2.9 and 3.8-2.7 times, respectively. The corresponding values for seed-straw of the next crop (faba bean) were 3.5-3.2, 3.7-4.2 and 4.1-4.4 times, respectively.

The aforementioned results indicated that the applied organic amendments affect directly or indirectly (residual effect) nutrients uptake, with a more pronounced beneficial effect extended to the next crop (faba bean). This means that the applied organic soil amendments are considered as a storehouse with easily mobile or available to uptake by plant roots. Consequently, these benefits are reflected positively on development of yield and its attributes for faba bean crop as a residual effect.

Table (6): Effect of applied organic amendments on the macro- micronutrients and their uptake by seed and foliage or straw of peanut and faba bean plants.

Treatment	Macronutrient contents %			Micronutrient contents (mg/kg)			Dry weight (kg fed^{-1})	Macronutrient (kg/fed)			Micronutrient (g/fed)		
	N	P	K	Fe	Mn	Zn		N	P	K	Fe	Mn	Zn
Peanut													
Seed													
Cont.	1.83	0.226	0.271	150	36.8	19.3	679	12.43	1.53	1.84	101.9	25.00	13.10
HA	3.06	0.412	0.612	258	57.6	33.8	1135	34.73	4.68	6.95	292.8	65.38	38.36
CMC	2.57	0.296	0.575	217	47.3	24.9	1016	26.11	3.01	5.84	220.5	48.06	25.29
PVAc	2.75	0.304	0.596	225	49.2	25.4	1143	31.43	3.47	6.81	25.72	56.23	29.03
CMC+HA	3.45	0.440	0.707	276	61.7	39.7	1197	41.29	5.27	8.46	330.4	73.85	47.52
PVAc+HA	3.53	0.452	0.723	282	62.1	40.3	1245	45.69	5.63	9.00	351.1	77.31	50.17
LSD at 0.05	0.13	0.03	0.62	47	4.7	3.12	163	6.27	1.01	0.92	59.60	9.53	11.70
	Foliage												
Cont.	1.16	0.118	0.857	192	31.2	24.2	1275	14.79	1.50	10.93	244.8	39.78	30.86
HA	1.84	0.241	1.245	279	45.5	32.5	1978	36.39	4.76	24.63	551.9	89.99	64.29
CMC	1.67	0.223	1.121	223	38.9	26.8	1905	31.81	4.29	21.36	424.8	74.10	51.05
PVAc	1.74	0.229	1.177	229	39.8	27.0	1968	34.24	4.51	23.16	450.7	78.33	53.14
CMC+HA	2.01	0.267	1.367	311	52.1	38.6	2110	42.41	5.63	28.84	656.2	109.9	81.45
PVAc+HA	2.13	0.273	1.385	321	53.4	39.1	2155	45.90	5.88	29.85	691.8	115.1	84.26
LSD at 0.05	0.72	0.03	0.07	75	2.70	1.90	178	1.11	0.91	2.1	95.4	87.9	17.81
Faba bean													
Seed													
Cont.	2.02	0.202	0.57	129	11.5	32.6	512	10.34	1.03	2.92	66.1	5.89	16.69
HA	3.14	0.271	0.681	234	13.7	57.7	665	20.88	1.80	4.53	155.6	9.11	38.37
CMC	2.78	0.365	0.704	160	18.2	45.6	615	17.10	2.24	4.33	98.4	11.19	28.04
PVAc	2.85	0.326	0.870	167	21.0	47.0	623	17.76	2.03	5.42	104.0	13.08	29.28
CMC+HA	3.64	0.400	0.829	243	23.1	74.2	756	27.73	3.02	6.32	185.2	17.60	56.54
PVAc+HA	3.69	0.405	1.090	298	28.8	90.7	775	28.59	3.14	8.45	230.9	22.32	70.20
LSD at 0.05	0.75	0.4	0.12	87	2.1	3.7	73	1.81	1.12	1.37	37.5	2.20	16.20
	Straw												
Cont.	0.47	0.128	1.08	288	18.5	16.7	1281	6.02	1.64	13.83	368.9	23.69	21.39
HA	0.72	0.197	1.57	508	42.6	39.4	1696	12.21	3.34	26.62	861.6	72.25	66.82
CMC	0.60	0.163	1.29	452	37.9	34.9	1455	8.73	2.37	18.77	657.7	55.14	50.78
PVAc	0.65	0.172	1.32	467	38.3	35.6	1479	9.61	2.54	19.52	690.7	56.64	52.62
CMC+HA	0.78	0.239	1.69	595	52.8	48.7	1845	14.39	4.41	31.18	974.2	97.42	89.85
PVAc+HA	0.80	0.246	1.72	623	54.5	49.2	1873	14.98	4.61	32.21	1166.9	102.1	92.15
LSD at 0.05	0.13	0.07	0.23	55	2.10	1.10	1023	2.11	1.01	3.90	237	45.1	22.10

Also, these findings indicated an important role for humic acid as in improving the efficiency of nutrients uptake, and in turn increasing the quantity and quality of both faba bean straw and seeds. These results are confirmed by **Mackowiak (2001) and Salib (2002)** who reported that the beneficial effect of humic acid on dry matter yield may be attributed to improve the bio-availability of micronutrients by complexion, which prevent early micronutrients deficiency.

REFERENCES:

Abd El-Hady, O.A. and S.M. Hefny, (2001): The conditioning effect of organic manure (natural) or/and acrylamide hydrogels (synthesized) on a sandy calcareous soil. 1: hydrophysical properties of soil. Egypt. J. Soil Sci., 30: 423.

Abd El-Hady, B.M., El-hady, O.A., Rizk, N.A. and , E.S. El-Saify (1997): The potentiality for improving plant-soil-water relation in sandy soil using some synthesized Am Na (or) ATEA hydrogels. 4 th Arab Int. Conf. on polymers Science and Tech. Sep. 8-11, (1997), Cairo, Egypt.

Abdel-Ghaffar, A.S. (1982): significance of organic materials to Egyptian agriculture and maintenance of soil productivity. FAO, Soil Bulletin, 45: 15.

Abdel-Mottaleb, M. A.; A.A. El-Wakell, R.M.; El Awady and Y.A. Awad (1989): The influence of soil conditioning on some physical of calcareous soil. Egypt. Soil Sci. Special Issue, pp. 293-305.

Abo El Soud, A.A.; M.A. El Deep and Kh.M. El Yamani (2004): Improving of faba bean productivity by application of organic compost and rhizobial inoculation under newly reclaimed sandy soil. Egypt.J.Appl. Sci.,19 (5): 333-344.

Askar, F.A.; A.S. Abdel-Chaffar and M.M. Attia (1989): influence of polyvinylacetate on the soil physical properties and productivity of wheat and soybean yield. Egypt. J. Soil Sci. , Special Issue, pp. 249.

Bligh, E.G. and W.J. Dyer (1959): A rapid method of total lipid extraction and purification. Canada J. Biochem. Physiol., 37: 911.

Brewer, R. (1964): Fabric and mineral analysis of soils. Wiley & Sons, New York, pp. 470.

Chapman, H.D. and P.F. Pratt (1961): Methods of Analysis for Soils, Plants and Waters. Univ. of California, Riverside, U.S.A.

Cheng, F.J.; D.Q. Yang and Q.S. Wu (1998): Physiological effects of humic acid on drought resistance of wheat. Chinese J. of App. Ecology, 1995, pp. 363-367.

De Boodt, M. (1988): Fighting surface salinity through the appropriate application of soil conditioners. Second Course on "modern Irrigation systems and related Problems" Ain Shams Univ., Cairo, Egypt, 12-31 March (1988).

Deyoe, C.W. and J.A. Shellenberger (1965): Amino acids and proteins in sorghum grain. J. Agric. and food Chem., 13:446.

El-Fakharani, Y.M. (1999): Combined effect of P fertilization and organic manuring on barley production in sandy soils. Fayoum J. Agric. Res.& Dev., 13,81.

El-Fayoumy, M. E. and H. M. Ramadan (2000): Effect of bio-organic manures on sandy soils amelioration and peanut productivity under sprinkler irrigation system. Egypt. J. Soil Sci., 42: 838.

El-Maghraby, S.E. (1997): Impact of natural conditioners and saline irrigation water frequency of calcareous soil productivity. Egypt J. Soil Sci., 37: 267.

El-Naggar, S.M.; F. Awad; N.W. Doering; G. Hair, and R. Burger (1988): Evaluation of supper absorbent polymer (hydrogel) and slow release fertilizer for improvement soil properties and plant growth in newly reclaimed areas of Egypt. Inter. Symp. "The use of soil conditioners for reclamation and Farming of Desert Land". Acad. Sci. Res. And Tech., 11-13 Oct. (1988) Cairo, Egypt.

Gomez, K.A. and A.A. Gomez (1984): Statistical procedures for Agricultural research, (2nd ed.), pp. 20-29 and 359-387.

Jackson, M.L. (1973): Soil chemical Analysis. Prentice-Hall of Indian private, Limited, New Delhi.

Kachinsky, N.A. and A.I. Mosolova, (1976): The application of polymers for artificial improvement of soil structure and amelioration. Med. Fac. landbouw. Rijks , Univ., Gent, 41: 437.

Khadr, M.S.; Abd El-Hadi, A.H.; Mohamed, Y.H. and El-Mobtasem, M.O. (1988): Effect of some soil amendments of the productivity of a sandy and a calcareous alkaline soil. Inter. Symp. "The use of soil conditioners for reclamation and Farming of Desert Land". Acad. Sci. Res. And Tech., 11-13 Oct. (1988) Cairo, Egypt.

Konovnova, M.M. (1966): Soil organic matter 2nd ed. Pergaman press, Oxford, UK.

Kotb, M.T.A. (1994): Soil and water management practices for some crops production. Ph. D. Thesis, Fac. of Agric., Zagazig, Univ., Egypt.

Lindsay, W.L. and W.A. Norvell (1978): Development of DTPA soil test for Zn, Mn and Cu. Soil Sci. Soc. Am. J., 24: 421.

MacCarthy, P.; C.E. Clapp; R.L. Malcolm and R.R. Bloom, (1990): Humic Substances in Soil and Crop Sciences. Selected Readings, American Society of Agronomy, Madison, Wisconsin.

Mackowiak, C.L. (2001): Beneficial effects of humic acid on micronutrients availability to wheat. Soil Sci. Soc. Am. J. 65: 1744.

Metwally, Sh.M. and M.A. Khamis, (1998): Comparative effects of organic and inorganic nitrogen sources applied to a sandy soil on availability of N and wheat yield. Egypt. J. Soil Sci., 38 (1-4): 35-54.

Nardi, M.R.; P. Diego; R. Fabiano and A. Muscolo (1999): Biological activity of humic substances extracted from soils under different vegetation cover. Commun. Soil Sci. Plant Anal., 30,621.

Page, A.I. ;R.H. Miller and Keeney, D.R. Eds. (1982): Methods of Soil Analysis. Part 2: Chemical and Microbiological Properties. 2 nd Ed., Amer. Soc. of Agron., Madison, Wiscosin, U.S.A.

Piper, C .S. (1950): Soil and Plant Analysis. Inter. Sci. Publisher Inc., New York, USA.

Poganiac, K.P. (1972): Artificial structure: Functional soil properties and soil productivity for cotton. FAN, Tashkent. USSR.

Richards, L.A. (1954): Diagnosis and Improvement of saline and alkali soils. Agric. Handbook No. 60. USD Agric., Washington, USA.

Salib, M.M. (2002): The integrated effect of humic acid and micronutrients in combination with effective micro-organisms on wheat and peanut grown on sandy soils. Zagazig J. Agric. Res., 29 (6): 2033-2050.

Stevenson, F.J. (1982): Humus chemistry, Genesis, Composition and Reaction. Wiley Inter. Science, New York, USA.

Stevenson, F.J. (1994): Humus chemistry, Genesis, Composition and Reaction. Wiley and Sons Inc., New York, USA.

Tester, C. F. (1990): Organic amendment effects on physical and chemical properties of a sandy soil. Soil Sci. Sco. Am. J., 54,827

Tayel, M.Y.; A. Ghazy; R.S. Abdel Aal and Sh.A. Wanas (2001): Improving sand soils using cellulose derivatives. 2: pore size distribution, soil water

retention, soil hydraulic conductivity and soil hydraulic resistivity. Egypt. J. Soil Sci., 41: 231.
Waly, A.F.A. (1996): Effect of some micronutrients on biochemical components of some plants. M. Sc. Thesis, Fac. of Agric., Cairo Univ., Egypt.
Wanas, Sh.A. (1996): Improvement of sandy soils by the use of hydrogels derived from agricultural and industrial wastes. Ph. D. Thesis, Fac. of Agric., Moshtohor, Zagazig Univ., Egypt.
Watanab, F.S. and S.R. Olsen (1965): Test of as ascorbic and method for determining phosphorous in water and Na HCO_3 extracts from soil. Soil Sci. Soc. Am. Proc., 29: 677.

الإنتفاع ببعض البوليميرات العضوية و حمض الهيوميك فى تحسين إنتاجية أرض رملية من الفول السودانى وتأثيراتها المتبقية على المحصول التالى من الفول البلدى

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أجريت تجربة حقلية علي نمط تركيب محصولى متعاقب من محصولين بقوليين لتفادى التأثير المتبقى للمحصول فى الموسم التالى، حيث تم زراعة الفول السوداني (جيزه ٥) كمحصول صيفي في أرض رملية تحت نظام الري بالرش في محطة البحوث الزراعية بالأسماعيلية، أعقبه الفول البلدي (جيزه ٢) كمحصول شتوي وذلك خلال الموسم الزراعي ٢٠٠٢/٢٠٠٣. وتهدف هذه الدراسة الي تحديد مدي الأستفادة المباشرة والتأثيرات المتبقية المفيدة الناجمة من إضافة بعض البوليميرات العضوية (الكربوكسي ميثيل سليلوز-CMC، البولي فينيل اسيتات- PVAc)، وكذا حمض الهيومك-HA علي بعض خواص التربة الرملية (الكثافة الظاهرية، المسامية الكلية، التوصيل الهيدروليكى، الثوابت المائية للتربة)، وكذلك قياسات النمو الخضرى والمحصول ومكوناته لكلا المحصولين تحت الدراسة، ممثلة فى الفول السودانى (محصولى الحبوب والعرش، دليل المحصول، وزن١٠٠ حبة، محتوى الحبوب من الزيت، المحتوي من البروتين والمغذيات الممتصة من النيتروجين والفسفور و البوتاسيوم والحديد و المنجنيز والزنك)، والفول البلدى (إرتفاع النبات، عدد الأفرع والأوراق/نبات، المادة الجافة للسيقان والأوراق، محصولى الحبوب والعرش، دليل المحصول، وزن١٠٠ حبة، المحتوي من البروتين والمغذيات الممتصة) . وكان معدل الإضافة ٢٪ وزن/وزن كمعاملات منفردة من البوليميرات العضوية أو معاملات مشتركة مع حمض الهيوميك (٥٠ مجم/كيلوجرام علي صورة هيومات البوتاسيوم الصلب)، حيث تم خلطهما جيدا مع الطبقة السطحية للتربة حتى عمق ١٥ سم.

وتشير النتائج المتحصل عليها إلى أن إضافة أضافة البوليميرات العضوية وحمض الهيومبك إلي التربة بصورة منفردة أو مشتركة (HA + PVAc and HA + CMC) قد أدي إلي زيادة معنوية وموجبة فى كل من خواص التربة وقياسات الفول السودانى تحت الدراسة، وبأفضلية مؤكدة للمعاملات المشتركة. وتوضح النتائج أن هناك تأثير مفيد قد إمتد وفى إتجاه موازى إلى محصول الفول البلدى (كأثر متبقي)، ولكن مع إستفادة أقل بالنسبة لجميع قيم خواص التربة والقياسات النباتية تحت الدراسة.

ومن الجدير بالملاحظة، أن إستخدام تلك المحسنات العضوية سواء كمعاملات منفردة أو مشتركة قد حقق كثير من التأثيرات المفيدة، والتى ربما ترجع إلى أن حمض الهيوميك يعمل كهرمون منشط لنمو النبات، أو رفع قدرة التربة على الإحتفاظ بالرطوبة والمغذيات للنباتات النامية كنتيجة لإضافة كل من الكربوكسي ميثايل سليلوز والبولي فينايل أسيتات اللذين يعملان كمواد خالبة تكون معقدات تحد من الفقد بالغسيل، ومثل هذه المواد الخالبة للماء والمغذيات من خلال مجموعات OH and COOH النشطة تعتبر مخزون عنصرى أكثر حركة وصلاحية وتيسرا للإمتصاص بواسطة الجذور النباتية، مما ينعكس إيجابيا على زيادة إنتاجية كلا المحصولين (الفول السودانى والفول البلدى) ومكوناتهما فى تلك التربة ذات الطبيعة الرملية.