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Hydrophilic Polymers for Improving the Conditioning Effect of Manures and Organic Composts. II.Hydrophysical Properties of Sandy Soil Planted with Tomato

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A COMPLETELY randomized field experiment with trickle irrigated tomatoes (*Lycopersican esculentum var.* 448) as the indicator plant was conducted at El-katta, Giza governorate to study the conditioning effect of hydrogels when mixed with or grafted on organic compost on some hydrophysical properties of a virgin sandy soil planted with tomatoes. Examined treatments were : a) untreated soil, b) soil treated with 0.5 kg and 1 kg organic compost (OM) /plant pit, c) soil treated with 2g and 4 g polyacrylamide K polyacrylate hydrogel (G)/plant pit, d) soil treated with 12.5 g and 25 g polyacrylamide K polyacrelate grafted on organic compost (grafted G)/plant pit. and e) soil treated with mixtures of 0.5 kg OM + 1g G, 0.5 kg OM + 2g G, 1kg OM + 1 g G and 1 kg OM + 2 g G /plant pit. At the end of the growing season, *i.e.*, after 150 days from plantation some hydrophysical properties of the soil were determined.

Applied conditioners positively affect hydrophysical properties of sandy soil. These include a) improving soil structure (in both dry and wet states expressed by water stable structure units > 0.25 mm in diameter and structure coefficient; dry stable structural units > 0.84 mm in diameter and wind erosion parameter) indicating high resistance of the soil against both wind and water erosion and the destruction of the soil by tillage operations, b) decreasing soil bulk density as well as macro porosity (drainage pores) on the expense of micro ones. Therefore, water holding pores were increased, c) increasing retained moisture in the soil at all suctions under study (from 0-15 atm.).

Because the increase in water retained in the soil at its field capacity is far beyond that at wilting percentage, available water was highly increased and d) decreasing mean diameter of soil pores and in turn its water transmiting properties namely: infiltration rate, hydraulic conductivity and transmissivity for vertical flow of water through soil profile. Evaporation was also decreased. In all cases, improvements in soil hydro-physical properties are positively affected by the application rate of the conditioners.

The improving effect of mixtures of OM and G exceeds that of each conditioner when solely added. Under the conditions of present work, applying 0.5 kg OM + 1 g G is nearly equal to that of applying

2g G and is much more effective ihan that of 1 kg OM /plant pit. Grafting G on OM leads to the production of an effective and economic soil conditioner.

Keywords: Sandy soil, Soil conditioning, Compost, Acrylamidc hydrogels, Soil structure, Moisture retention. Water transmitting properties.

Cultivation of sandy soil's is of the main targets for the horizontal expansion of the planted area to meet food and dress demands of oveipopulation m Egypt. These coarse texturai soils have many common features, namely: low water retention and ion exchange capacities, poor structure development, low humus content and high infiltration rate together with the problems of wind erosion and degradation. Under irrigation, severe losses of precious water and applied nutrients occur and desired yield levels are difficult to attain. Management of these soils calls for specialized approaches for sustainable productivity (Balba, 1999).

Organic manures and composts as natural soil conditioners and super absorbent materials (hydrogels) as synthesized ones were used in Egypt and abroad for reclaiming sandy soils. Application rates ranged between 10 and 20 tons/fed for the former (Badran, Nadia, 19S3; Montasser, 1987 and Sakr *et QL,* 1992) and 6 and 200 kg/fed for the latter (El-Hady, 19S7a & b; Rasheed *et aL,* 1997 and El-Hady & Wanas, 2006). It was expected that applying the proper hydrogel mixed with or grafted on composts to the soil may be more effective and economic than using each of them alone (El-Hady *et al,* 2000 and 2002a & b; El-Hady & El-Dewiny, 2006 and El-Hady & Abo-Sedcra, 2006).

A two successive years field experiment was conducted on a sandy soil at EL- Katta, Giza govemorate, Egypt to study the conditioning effect of hydrogels when mixed with or grafted on organic composts on production and water and fertilizers use efficiency by growing plants where tomato *{Lycoperaican esculentum, L* var. 448) was taken as the indicator crop. Obtained data proved the importance of using either organic composts or hydrogels or both together for increasing the agricultural potentialities of sandy soils under the severe conditions of our deserts, *i.e.,* the limited water resources and the inadequate water retention and low fertility of such soils. Grafting G on OM led to the production of an effective soil conditioner. Incorporating this conditioner in sandy soil improved its productivity and both water and fertilizers use efficiency by growing plants (El- Hady *et* «/., 2006).

The conditioning effects of examined hydrogels when mixed with or grafted on organic compost on some hydrophysical properties of sandy soil after tomato plantation, /.&, soil structuralization and stabilization, pore size distribution, moisture retention and water transmission in the soil were the aims of the present work.

Material and Methods

A completely randomized field experiment with four replications for each treatment with plot area (1/100 feddan) *i.e.*, 120 plant pits was conducted on a sandy soil at EL- Katta, Giza governorate, Egypt (Steel & Torrie, 1980). Trickle irrigated Tomato (*Lycopersicon esculentum, L* var. 448) was chosen as the indicator plant. This choice was for its capability to fruit setting under severe conditions of our deserts particularly drought and salinity (El-Hady *et al.*, 2006). Analytical data of the soil are presented in Table 1. Fine compost (OM) produced by aerobic composting of some local organic wastes, *i.e*, town refuse, sawdust, plant residues and organic manure at the ratio of 1:1:1:1, respectively was applied.

TABLE 1. The main analytical data of the soil.

1-Mechanical analysis				
Sand		Silt	Clay	Soil Texture
Coarse >200 μ %	Fine 200-20 μ %	20-2 μ %	< 2 μ %	
50.6	41.4	4.4	3.6	Sandy

2-Chemical analysis										
PH (1:2.5)	EC (dSm^{-1})	$CaCO_3$ %	OM %	Cations (meq/L) 1:5 extract				Anions (meq/L) 1:5 extract		
				Ca^{++}	Mg^{++}	K^{+}	Na^{+}	Cl^{-}	HCO_3^{-1}	SO_4^{-2}
7.8	1.1	6.2	0.1	3.0	1.6	0.2	7.2	6.8	1.9	3.3

3-Hydrophysical analysis					
Bulk density ($Mg\ m^{-3}$)	Total porosity (%)	Total water holding capacity* (%)	Field capacity* (%)	Wilting percentage*	Hydraulic conductivity $m\ day^{-1}$
1.61	39.25	19.61	6.27	1.32	11.6

*On weight basis

Two types of hydrogels (30% anionicty) were prepared to be examined as soil conditioners or improvers for organic waste composts. These are: 1) *polyacrylamide K polyacrylate gel (G)*. It was prepared at the Polymers and Pigments Dept., National Research Center. Ammonium peroxy di sulphate $(NH_4)_2S_2O_8$ was used as the initiator (initiator ratio = 0.14%) while tri- ethanol amine $(CH_3\text{-}CH_2)_3N$ was used as the cross linker (cross linker ratio = 1.7%).

Temperature and time of polymerization were 30 ° and 1.5hr, respectively (El-Hady *et al.*, 2003). 2) *polyacrylamide* K polyacrylate gel grafted on wooden waste compost (grafted G). It was prepared by ionizing radiation at the National Center for Radiation Research and Technology, Atomic Energy Authority of Egypt, Nasr City, Cairo. Aqueous solution of water-soluble acrylamide – acrylate co-polymer was stirred with the water saturated organic waste compost. Few milliliters of Conc. H_2SO_4 were added to accelerate graft copolymerization. The reaction mixture was subjected to Co^{60} gamma cell. The gellation dose was met at an absorbed dose of 10 K Gy for 3 hr. The polymer –grafted organic was thoroughly washed with water to extract residual monomers and H_2SO_4 before drying under vaccum at 50° for 24 hr (Abd El-Rehim, *et al*., 2004). The main constituents and properties of organic compost and hydrogels used are given in Tables 2 and 3, respectively.

The treatments were

- Treatment no 1: non-conditioned soil (mineral fertilization only).
- Treatments no 2 and 3: soil of treatment no 1 conditioned with 0.5 and 1kg compost (OM)/plant pit, *i.e.*, 6 and 12 tons/fed, respectively.
- Treatments no 4 and 5: soil of treatment no 1 conditioned with 2g and 4g hydrogel (G)/plant pit, *i.e.*, 24 and 48 kg/fed, respectively.
- Treatments no 6 and 7: soil of treatment no 1 conditioned with 12.5g and 25g grafted hydrogel (grafted G)/plant pit, *i.e.*, 150 and 300 kg/fed, respectively.
- Treatment no 8: soil of treatment no 1 conditioned with 0.5kg OM +1g G/plant pit, *i.e.*, 6 ton OM +12kg G/fed.
- Treatment no 9: soil of treatment no 1 conditioned with 1kg OM +1g G/plant pit. *i.e.*,12 ton OM +12kg G/fed.
- Treatment no 10: soil of treatment no 1 conditioned with 0.5kg OM +2g G/plant pit, *i.e.*, 6 ton OM +24kg G/fed.
- Treatment no 11: soil of treatment no 1 conditioned with 1kg OM +2g G/plant pit, *i.e.*, 12 ton OM +24kg G/fed.

TABLE 2. Some chemical properties of applied compost.

PH (H_2O)	7.32
Salinity: EC dSm^{-1}	1.3
Na^+ %	0.02
Moisture %	4.11
Mineral content: (Ash) %	28.80
Organic component: OM %	67.09
OC %	38.91
ON %	2.09
C:N	15.75
Macro elements: $NH_4^+ + NO_3$ %	0.02
P_2O_5 %	0.38
K_2O %	0.48
Secondary elements: Ca^{+2} %	1.12
Mg^{+2} %	0.36
Micro elements: Fe ppm	116.0
Mn ppm	51.0
Zn ppm	45.0
Cu ppm	12.5
Heavy metals: Cd ppm	0.40
Co ppm	0.60
Ni ppm	2.02
CEC c mole kg^{-1}	135

TABLE 3. The main properties of applied hydrogels.

Property	polyacrylamide K polyacrylate Gel	polyacrylamide gel grafted on wooden waste compost
Appearance	White to slightly yellow grains	yellow to light brown grains
Grain size	0.25 - 1 mm	2 - 5 mm
Bulk density	~ 600 kg m^{-3}	~ 450 kg m^{-3}
Solubility	Insoluble in water and organic solvents	
pH(0.1%) in distilled water	7.1	7.5
CEC c mole kg^{-1}	2045	445
Absorption capacity(g/g gel):		
deionized water	567	151
Irrigation water (500 ppm)	296	82
Absorption time		
up to 50%	20 minutes	15 - 20 minutes
Total absorption	~ 60 minutes	30 - 60 minutes

The conditioning effects on some hydrophysical properties of the soil, either conditioned or not were determined at the end of the growing season, *i.e*, after 150 days from plantation according to (El-Shafei & Ragab, 1976; El-Hady & El-Sherif, 1988; Dewies & Freitas, 1970; Loveday, 1974 and Klute, 1986). The studied properties are:

a-Water stable structural units > 0.25 mm in diameter and structure coefficient.

b-Dry stable structural units > 0.84 mm in diameter and wind erosion parameter.

c-Soil bulk density, total porosity and pore size distribution.

d-Moisture retention at different tensions and available moisture.

e-Infiltration rate, hydraulic conductivity, mean diameter of soil pores and transmissivity for vertical flow of water through the soil profile.

f-Adjusted evaporation.

Results and Discussion

Some hydro physical properties of the soil, *i.e.*, structure stability, porosity and pore size distribution, moisture retention and water transmissivity as influenced by conditioning the soil with O.M; G; mixtures of OM and G and grafted G are presented in Table 4. Wet sieve analysis was used to determine the percent of water stable fraction > 0.25 mm in diameter and this fraction was taken as a reflection of soil aggregate stability (El-Hady & El-Sherif, 1988). Data show that addition of either OM or G resulted in an increase in this fraction being higher with increasing the application rate of applied conditioners. Moreover

2g/plant pit of examined G seems to be more effective in improving this property than that of 1kg/ plant pit OM. In other words, while incorporating 1kg OM in the plant pit increased the percentage of water stable structural units > 0.25 mm in diameter by 42.1%, the increase in this fraction due to the addition of 2g/ plant pit of the examined hydrogel was 104.7%, *i.e.*, about 2.5 times that of the higher application rate of OM. Incorporating both OM and hydrogel together into sandy soil was more efficient than applying each of them alone. Water stable structural units > 0.25 mm in diameter were about 1.9, 2.7, 2.1 and 2.7 times that of untreated soil by treating the plant pit with 0.5 kg OM + 1g G, 0.5kg OM + 2g G, 1kg OM + 1g G and 1kg OM + 2g G, respectively. Improvements in this property by applying grafted G were 104.7 and 139.2% that of untreated soil with 12.5 and 25g grafted G/ plant pit, respectively. In order to find out the aggregating capacity and to compare quantitatively the different treatments, structure coefficient (Cr) was calculated. This coefficient is the ratio between the percentage of the total amount of fractions greater than 0.25mm in diameter and the percentage of fractions having the diameter less than 0.25 mm as suggested by El-Shafei & Ragab (1976). Calculated Values reveal a marked increase in (Cr) as a result of applying either OM or G or both together. Using 0.5kg and 1kg OM/ plant pit, raised this index to be 1.2 and 1.6 times that of the control. With regard to G treatments, Cr values were 2.6 and 3.8 times as that of the untreated sandy soil by mixing the plant pit with 2g and 4g G, respectively. Applying the two techniques together for sandy soil conditioning, raised the (Cr) values to be 2.3, 2.8, 4.1 and 4.3 times that of untreated soil with the mixtures of 0.5 kg OM + 1g G, 0.5kg OM + 2g G, 1kg OM + 1gG and 1kg OM + 2g G/ plant pit, in sequence. Using 12.5 and 25g grafted G/ plant pit raised (Cr) values to be 2.6 and 3.3 times that of untreated soil, respectively. It is well known that the higher this index is the more stable is the soil structure.

Dry stable structural units > 0.84 mm in diameter are used as criteria to evaluate soil mechanical stability and the resistance of the structural units of sandy soil against breakdown by tillage or by wind erosion (El-Hady, 1984). Under the conditions of the research the increase in dry stable structural units > 0.84 mm in diameter were 191 and 327% with 2g and 4g G versus 77 and 132% with 0.5kg and 1kg OM/ plant pit, respectively. Mixing OM with G raised the percentages of dry stable structural units > 0.84 mm in diameter to be 281, 364 , 298 and 416% that of untreated soil by applying 0.5 kg OM + 1g G, 1kg OM + 1g G, 0.5kg OM + 2g G and 1kg OM + 2g G, respectively. Moreover, percentages of dry stable structural units > 0.84 mm in diameter when using 12.5 or 25g grafted G were 241 or 308% higher than that of untreated soil. Wind erosion parameter was calculated as the ratio between the percentages of the structural units > 0.84 mm in diameter of the untreated soil and those of the treated ones. The lower the calculated parameter is the more stable is the soil (El-Hady & El-Sherif, 1988). Incorporating 1kg OM in the plant pit reduced this parameter by 56.9%, while the reduction was 65.6 and 76.6% with 2g and 4g G/plant pit, respectively. Moreover, wind erosion parameter of sandy soil treated with mixtures of OM and G were lower than that of untreated soil by 49, 64, 73, and 76% for the treatments 0.5kg OM + 1g G, 1kg OM + 1g G, 0.5kg OM + 2g G and 1kg OM + 2g G/ plant pit, respectively. Furthermore, using grafted G reduced wind erosion parameter to be 30 and 25% that of untreated soil with 12.5 and 25g/ plant pit, in sequence.

Values of soil bulk density, soil porosity and micro- porosity as influenced by treating the soil with OM, G, grafted G and mixtures of OM and G reveal that soil conditioning decrease the bulk density of the soil as well as the macro porosity (drainable pores having the diameter of >28.8μ) relative to those of untreated soil. This decrease was calculated to be 1.2 and 1.9% for the bulk density and 7.4, and 11.5% for the macro porosity due to the application of 0.5kg and 1kg OM/plant pit respectively. It is of interest to mention that the macro porosity was taken as the air filled porosity when the soil water system was in equilibrium with 100 cm suction (Loveday, 1974). Relevant values were 3.4 and 4.3% for the bulk density and 20.6 and 28.4% for the macro porosity when applying 2g and 4g G/ plant pit, respectively. Using grafted G as a soil conditioners, values of soil bulk density and macro pores were decreased by 3.2 and 4.3% for the former and by 18.5 and 28.0% for the latter by treating the soil with 12.5 and 25g/ plant pit, in sequence.

In regard to the effect of added conditioners on total porosity and micro porosity, specially those which hold available moisture to plants, (*i.e.*, water holding pores having the diameters of 28.8- 0.19μ), the data took an opposite trend to that of bulk density and macro porosity. On other words, the increases relative to those of the control that reached 2.0 and 2.9% in total porosity and 35.4 and 54.0% in water holding pores were obtained in soil when conditioned with 0.5kg and 1kg OM/ plant pi, respectively. This increase was 53 and 65% and 99.2 and 133.1% by treating the plant pit with 2g and 4g G, and by 5.0 and 6.7% and 89.7 and 132.1% by applying 12.5 and 25g grafted G/ plant pit, in sequence. The ratio between micro and macro pores is of great importance in revealing the rate of water retention and water movement in the soil. It is interesting to note that addition of both types of soil conditioners to the sandy soil beneficially modify this ratio. While micro: macro porosity in the untreated soil was 0.35: 1, it increased by soil conditioning to be 0.48: 1 and 0.56: 1 due to the addition 0.5kg and 1kg OM/ plant pit, respectively and reached about 1:1 by applying 4g G or 25g grafted G to each plant pit indicating slow water movement and more water retention in the soil as will be presented latter.

Data of the combined effect of both OM and G when mixed together before addition to sandy soil on the aforementioned parameters, Table 4 showed also the decrease in bulk density and percentage of macro pores of the treated soil. It seems that mixing OM with G is more effective than applying each of them alone. The decrease in bulk density of the soil relative to that of the control treatment were 5.0, 6.2, 5.3 and 7.5% with 0.5kg OM + 1g G, 0.5kg OM + 2g G, 1kg OM + 1g G and 1kg OM + 2g G/ plant pit, respectively. Similarly, the decrease in the percentages of macro pores due to the application of mixtures of OM and hydrogel were calculated to be 11.5, 16.5, 17.7 and 19.4% for the mixtures mentioned above, in sequence. On the other hand, total porosity and water holding porosity showed higher values by incorporating mixtures of OM and G in sandy soil. While applying 1kg OM alone/ plant pit increased total porosity and water holding porosity by only 2.9 and 54.0%, respectively. Conditioning the studied soil with only 0.5kg OM + 1g G increased soil porosity by 7.7% and soil water holding pores by 77%. Increasing applied OM to be 1kg and mixed with 1g G showed no considerable reduction in soil bulk density and macro porosity and in turn a corresponding increase in the percentages of total porosity and water holding pores indicating that the lowest rate of OM (*i.e.*, 0.5kg), may be sufficient for improving such soil properties when mixed with hydrogels. More increase in applied G to be 2g greatly improved pore size distribution of treated soils towards high moisture retention and lower loss of water from the soil by leaching or deep percolation. This could be indicated by the modification of micro: macro porosity. Incorporating 1kg OM mixed with 2g G in sandy soil increased this ratio to be ~2.5 times that of the control treatment.

Retained moisture in the soil under different suctions as influenced by soil conditioning is shown in Table 4. Data in hand refer to an increase in the percentages of retained moisture at all suctions under study due to soil conditioning being higher with increasing the application rate of either OM or G or both.

At saturation (*i.e.*, at pF=0), the total water holding capacity (WHC) of the soil was increased by 7.5 and 8.7 % when incorporating 0.5kg and 1kg OM in the plant pit, respectively. Applying G to sandy soil increased also its WHC by 11.9 and 13.9% when 2g and 4g G was incorporated into the plant pit, respectively. Relevant values for the treatments 12.5 and 25g grafted G/ plant pit were 12.9 and 15.4%, respectively. Moreover, WHC of the soil was increased by 12.2 and 17.0% if 0.5kg OM was mixed with 1 and 2g G, in sequence. More increase in retained moisture at saturation was obtained by doubling the application rate of OM to be 1kg/ plant pit mixed with hydrogel. Under such conditions WHC values of the soil were 113.4 and 121.0% that of the untreated soil with 1 and 2g G, respectively.

At field capacity (FC) *i.e.*, at pF =2.0, values of retained moisture show increases of 30.5 and 46.7% relative to that of the control by applying the same levels of OM mentioned above (*i.e.*, 0.5kg and 1kg/ plant pit, respectively). Conditioning the soil with hydrogels also raised the amount of moisture retained into the soil at its field capacity over that of the untreated soil by 86.3 and 116.1% for 2 and 4g G/ plant pit and by 78.8 and 129.3% for 12.5 and 25g grafted G/ plant pit, in sequence. Conditioning the soil with mixtures of OM and G, increased also the amount of moisture retained into the soil at its FC to be 1.72, 2.11, 2.06 and 2.17 times that of the control treatment by treating the soil with 0.5kg OM + 1g G, 0.5kg OM + 2g G, 1kg OM + 1g G and 1kg OM + 2g G, in sequence.

Since the increase in water retained at FC is far beyond that at wilting percentage (WP) *i.e.*, at pF= 4.2, the available water (FC-WP) increased, So incorporating 0.5kg and 1kg OM/ plant pit raised available moisture to be 1.37 and 1.57 times that of untreated soil, respectively. Moreover, applying 2g and 4g G/ plant pit increased available moisture to be 2.06 and 2.42 times respectively, compared to control treatment. Regarding the effect of OM and G mixtures on the available water, applying 0.5kg OM mixed with 1g of the hydrogel/ plant pit increased soil available water to be 1.86 times that of untreated soil. The increase in available water over that of the control treatment due to treating the soil with 0.5kg OM mixed with 2g of the aforementioned G was 135%. Moreover, available water of sandy soil treated with 1kg OM mixed with 1 and 2g G/ plant pit reached 2.31 and 2.42 times that of untreated soil, respectively. Relevant values for the treatments 12.5 and 25g grafted G/ plant pit were 1.97 and 2.6 times, in sequence.

Data presented in Table 4 show also that conditioning sandy soil with either compost or hydrogel decreased the values of the studied water transmitting properties. Moreover, the combined effect of incorporating both OM and G together into sandy soil or applying grafting G was clear where the values of these properties were much lower. In this respect, the decrease in water transmitting properties of sandy soil due to the addition of 1kg OM to the plant pit reached 42.3, 38.7, 21.4, 27.1 and 19.5% that of untreated soil for the infiltration rate, hydraulic conductivity, mean diameter of soil pores, transmissivity for vertical flow of water through the soil profile and adjusted evaporation, respectively. With 4g G/plant pit these decrease were 53.2, 61.6, 38.1, 43.1 and 39.5% that of untreated sandy soil for the aforementioned properties, in sequence. Regarding the combined effect of both techniques of sandy soil conditioning, *i.e.*, organic composts mixed with acrylamide hydrogel or grafting the hydrogel on the compost, application seems to be additive and more effective than using each of them alone. Incorporating 0.5kg OM with 1g of the examined G reduced the water transmitting properties of the soil under study by 44.9% for the infiltration rate, 49.8% for the hydraulic conductivity, 29.0% for the mean diameter of soil pores, 34.9% for the transmissivity for vertical flow of water and 23.7% for adjusted evaporation. Doubling the application rate of OM to be 1kg and mixing it with only 1g of G/ plant pit caused more reduction in the studied parameters to reach 50.1, 57.2, 34.3, 40.1 and 31.0% that of untreated soil for the properties mentioned above, respectively. More decrease in the values of the studied parameters was obtained by raising the application rate of both mixture components, *i.e.*, G and OM to be 2g for the 1st and 1kg for the 2nd / plant pit. Under these conditions, values of the studied properties were ~ 0.5 that of untreated soil for the infiltration rate of the soil and its hydraulic conductivity and 0.6-0.7 that of untreated sandy soil for the other properties. On the other hand, reduction in the soil transmitting properties due to applying 12.5 or 25g grafted G were 47.7, 55.6, 33.3, 38.9 and 38.8% or 50.7, 60.9, 37.0, 42.6 and 41.9% for the aforementioned properties in sequence.

TABLE 4. Effect of organic compost or/and acrylamide hydrogels on some hydrophysical properties of sandy soil.
a) Soil structural and pore size distribution.

Treatments			Water stable structural units (>0.25mm) %	Structure coefficient (Cr)	Dry stable structural units (>0.84 mm) %	Wind erosion parameter	Bulk density Mg m^{-3}	Total porosity %	Macro pores (drainable pores >28.8μ)	Micro pores (<28.8μ)		Micro: macro
No	OM kg/ Plant pit	G g/ Plant pit								Water holding pores (28.8-0.19μ)	Fine capillary pores (<0.19μ)	
1	-	-	17.20	0.208	10.6	1.0	1.610	39.24	29.15	7.94	2.15	0.35
2	0.5	-	20.15	0.252	18.8	0.564	1.590	40.00	27.00	10.75	2.25	0.48
3	1.0	-	24.45	0.324	24.6	0.431	1.580	40.38	25.85	12.23	2.30	0.56
4	-	2	35.20	0.543	30.8	0.344	1.555	41.32	23.15	15.82	2.35	0.78
5	-	4	44.16	0.791	45.3	0.234	1.542	41.80	20.90	18.51	2.39	1.00
6	12.5 g grafted G		35.12	0.541	36.1	0.294	1.558	41.21	23.75	15.06	2.40	0.74
7	25.5 g grafted G		41.15	0.699	43.2	0.245	1.541	41.85	21.00	18.43	2.42	0.99
8	0.5	4	32.15	0.474	29.8	0.356	1.530	42.26	25.80	14.05	2.41	0.64
9	1.0	1	46.20	0.859	38.6	0.275	1.525	42.45	25.60	14.41	2.44	0.66
10	0.5	2	36.60	0.577	31.6	0.335	1.510	43.02	24.35	16.21	2.46	0.77
11	1.0	2	47.15	0.892	44.1	0.240	1.490	43.77	23.50	17.77	2.50	0.86

TABLE 4. Contd .

b) Moisture retention and Water transmitting properties .

Treatments			Water holding capacity (WHC)*	Field capacity (FC)*	Wilting percentage (WP)*	Available moisture*	Infiltration rate of air dry soil	Hydraulic conductivity	Mean diameter of soil pores	Transmi-ssivity	Adjusted evaporation
No	OM kg/ Plant pit	G g/ Plant pit	%	%	%	%	cmh^{-1}	m.day^{-1}	(μ)	(Σ k/D) day^{-1}	(E adj.)
1	-	-	23.11	6.27	1.34	4.93	72.8	11.60	21.0	110.47	1.000
2	0.5	-	24.85	8.18	1.42	6.76	46.7	8.12	17.6	87.27	0.851
3	1.0	-	25.12	9.20	1.46	7.74	42.0	7.11	16.5	80.54	0.805
4	-	2	25.86	11.68	1.51	10.17	35.9	5.81	14.9	71.87	0.668
5	-	4	26.33	13.55	1.55	11.95	34.1	4.46	13.0	62.87	0.605
6	12.5 g grafted G		26.10	11.21	1.52	9.69	38.1	5.15	14.0	67.47	0.612
7	25.5 g grafted G		26.68	14.38	1.57	12.81	35.9	4.54	13.2	63.41	0.581
8	0.5	1	25.94	10.76	1.58	9.18	40.1	5.82	14.9	71.94	0.763
9	1.0	1	26.21	12.94	1.57	11.37	36.3	4.96	13.8	66.21	0.690
10	0.5	2	27.05	13.20	1.63	11.57	37.2	5.34	14.3	68.74	0.635
11	1.0	2	27.96	13.60	1.68	11.92	36.1	4.82	13.6	65.27	0.615

* On weight basis.

Comparing the conditioning effect of applied OM and G, it is obvious that soil hydrophysical properties related to soil structuralization and stabilization, water preservation and water movement were greatly improved using 2g G/ plant pit (24 kg/fed.) much more better than that when applying even 1kg OM/ plant pit (12 ton/fed.). The combined and interacted effects of applying both technologies for soil conditioning together on hydrophysical properties of the soil were practically proved. The beneficial effect of mixing 0.5kg OM with 1g G or applying 12.5g grafted G/ plant pit on all the studied hydrophysical properties of the soil has exceeded that of 1kg OM or 2g G if each of them was solely applied to the plant pit. Although mixing 1kg OM with 2 g G cause better improvement in soil properties, the higher moisture retention in the treated soil over the needs of the growing plants and the adverse effects on the aeration of the root zone as a result of increasing the soil micro porosity on the expense of its macro ones may explain why the yield and both water and fertilizers use efficiency by growing plants did not change by an increased amount of applied conditioners (El-Hady *et al.*, 2006 1st part of this research work). Therefore, 0.5kg OM mixed with 1g G or 12.5 g grafted G/ plant pit seems to be the recommended dose to get use of the benefits of both types of soil conditioners without adverse effects on growth and water and fertilizers use efficiency by plants.

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دور البوليمرات المحبة للماء فى تحسين الاستفادة من الأسمدة والمكمورات العضوية
٢- الخواص الهيدروفيزيائية لارض رملية منزرعة بالطماطم.

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أجريت تجربة حقلية فى نظام تام العشوائية لمدة موسمين زراعيين متتاليين على الطماطم (هجين ٤٤٨) كنبات دليلى زرعت فى تربة رملية بمنطقة القطا بمحافظة الجيزة تحت نظام الرى بالتنقيط لدراسة الأثر التحسينى لمركبات الهيدروجيل عند خلطها ب أو تحميلها على مكمور عضوى (كمبوست) على الخواص الهيدروفيزيائية للتربة.
وكانت المعاملات تحت الدراسة كالاتى:
١-تربة غير معاملة بالمحسنات(تسميد معدنى فقط). ٢ ، ٣ -تربة رقم ١ مع معاملة جورة النبات ب ٠,٥ كجم ، ١ كجم كمبوست (٦ ، ١٢ طن /فدان على التوالى). ٤ ،٥ – تربة رقم ١ مع معاملة جورة النبات ب ٢ جم ، ٤ جم بولى أكريلاميد هيدروجيل (٢٤ ، ٤٨ كجم /فدان على التوالى). ٦،٧ -تربة رقم ١ مع معاملة جورة النبات ب ١٢,٥ ، ٢٥ جم بولى أكريلاميد هيدروجيل تحمل على الكمبوست (١٥٠ ، ٣٠٠ كجم /فدان على التوالى). ٨ ،٩ ،١٠ ،١١ -تربة رقم ١ مع معاملة جورة النبات بخليط من ٠,٥ كجم كمبوست +١ جم هيدروجيل ، ١ كجم كمبوست +١ جم هيدروجيل، ٠,٥ كجم كمبوست + ٢ جم هيدروجيل ، ١ كجم كمبوست + ٢ جم هيدروجيل على التوالى.

وتم تقدير بعض الخواص الهيدروفيزيائية للتربة فى نهاية موسم النمو أى بعد ١٥٠ يوم من زراعة الشتلات. ويمكن تلخيص النتائج المتحصل عليها فى الأتى:

أولا: المحسنات المضافة تؤثر إيجابيا على الخواص الهيدروفيزيائيه للتربة والتى تتمثل فى:
أ-تحسين بناء التربة معبرا عنه بالوحدات البنائية الثابتة فى الماء ذات الأقطار > ٠,٢٥ مم ومعامل البناء وكذلك بالوحدات البنائية الجافة الثابتة ذات

الأقطار >٠,٨٤ مم ، ودليل الانجراف بالرياح مؤكدة إيجابية المقاومة العالية للتربة ضد الانجراف المائى والانجراف بالرياح وفعل الهدم الناتج عن عمليات الخدمة.

ب- تقليل كل من الكثافة الظاهرية للتربة والمسام الواسعة (مسام الصرف) على حساب المسام الدقيقة.وتبعا لذلك تزداد مسام حفظ الرطوبة فى التربة.

ج- زيادة الرطوبة المحتجزة فى التربة تحت كل قوى الشد الرطوبى التى درست. وبما أن الزيادة فى الماء المحتفظ به فى التربة عند سعتها الحقلية يزيد كثيرا عن مثيله عند نقطة الذبول فإن الماء القابل للاستفادة بالنبات يزداد زيادة كبيرة.

د-تقليل القطر المتوسط للمسام وتبعا لذلك قياسات حركة الماء فى التربة معبرا عنها بمعامل النفاذية والتوصيل الهيدروليكى وحركة الماء راسيا فى القطاع الأرضى.

هـ- إنخفاض البخر من سطح التربة.

ثانيا: التأثير المحسن لمخاليط الكمبوست والهيدروجيل يفوق تأثير أى منهما إذا ماأضيف بمفرده. كما يعتبر معدل إضافة الخليط ومكوناته من العوامل الهامة المؤثرة على كفاءة عملية التحسين. وتحت ظروف الدراسة كان تأثير إضافة خليط من ٠,٥ كجم كمبوست + ١ جم هيدروجيل/ جورة نبات يقارب تأثير إضافة ٢ جم هيدروجيل ويزيد كثيرا عن تأثير إضافة ١ كجم كمبوست/ جورة نبات.

ثالثا: تحميل مركب الهيدروجيل على الكمبوست يؤدى إلى إنتاج محسن أرضى مؤثر وإقتصادى فى نفس الوقت