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IMPROVEMENT OF SANDY SOIL CHARACTERISTICS AND ITS PRODUCTIVITY OF WHEAT CROP USING ORGANIC AND MINERAL-N FERTILIZATION

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ABSTRACT: ***A field experiment was carried out on sandy soil at the Farm of Ismailia Agric. Res. Station, Ismailia Governorate, Egypt (Latitude, 30^o 35' 41.901" N and longitude, 32^o 16' 45.834" E) during the two successive growing winter seasons, i.e., 2016 / 2017 and 2017 / 2018 on wheat plant (Triticum aestivum L.) variety Misr 1, to study the individual and combined effect of organic fertilizers (farmyard manure or potassium humate) and mineral nitrogen fertilization levels (0, 50, 75 and 100 kg N fed.$^{-1}$ as ammonium nitrate "33.5 % N") on plant growth, yield and its components as well as nutrient contents, apparent nitrogen recovery efficiency (ANRE) and agronomical efficiency, also on some chemical and physical properties of the studied soil. Application rates of farmyard manure (FYM) were 0 and 5 ton fed.$^{-1}$, while potassium humate at rates of 0 and 5 kg fed.$^{-1}$. The layout of the experiment was a split- plot design, with the main plots arranged in a randomized complete blocks design, with three replicates.***

The results showed that, there are a significant increases of the estimated growth parameters, i.e. plant height (cm), spike length (cm), number of tillers/ plant, number grains/ spike as well as straw and grain yields of wheat plants and their content (concentration and uptake) of the determined macro- (N, P and K) and micro- (Fe, Mn and Zn) nutrients and protein content as a result of N, FYM and K-humate applications in both individually and together. The highest values of these determinations were found in the plants fertilized by N + FYM followed by these resulted from the treatment of N + potassium humate, except weight 1000 grains, grain yield and K content which gave the highest values with the treatment of N + potassium humate. In addition, individual applications of N resulted in a decrease in the soil content of available macro- (N, P and K) and micro- (Fe, Mn and Zn) nutrients, but increased the soil content of available compared with the control treatment. On the other hand, there are an increase of soil content of available macro- and micro-nutrients under study as a result of individual applications of FYM and K-humate with the superior increase of FYM compared with that with K-humate, except the soil content of available K. Also, the soil content of OM was decreased with the increase of added N, but increased as a result of FYM and K-humate applications alone. Soil bulk density was increased in the fertilized by N alone and decreased in the soil fertilized by individual applications of FYM and K-humate.

The obtained data from this study concluded that, under sandy soil conditions, organic fertilizers played a major role in sandy soil fertility and its productivity of wheat plants and it's become more efficiency if its application in combination with mineral nitrogen fertilization.

Key words: ***Sandy soil, Farmyard manure, Potassium humate , Mineral nitrogen fertilizer , Wheat plants , Growth parameters and Chemical composition.***

INTRODUCTION

For the urgent need to meet food and dress demands in Egypt, more desert areas either sandy or calcareous have to be put under cultivation. Such soil are poor with respect to their physic-bio-

chemical properties, soil water-plant relationships as well as their nutritional status. Sandy soils in Egypt represents more than 70 % of total area. Most of these soils may be reclaimed with low costs compared with other desert soils. Also, these soils are more suitable to many economical cultivations such as wheat, barley and corn. In addition, such soils are located within or near to the Valley of Nile River (FAO, 2011).

Farmyard manure has played an important role in the continuous supply of well-balanced diets of nutrients to crops and represents an important component of the nutrients cycle in agricultural ecosystems. Ali *et al.* (2005) indicated that pH and EC values were slightly decreased with FYM application at rate of 2 or 3% to sandy soil after harvesting maize. Several studies have assured the roles of organic amendments as an improving agent. The improvement of soil physical and chemical properties as well as nutrients status depends to a great extent on the rational use of organic materials as amendments. Seddik (2006) found that N, P and K contents in studied plant parts as well as yield components for both tomato and pea plants generally increased with application of organic manure (FYM and chicken manure) and natural minerals. Farm yard manure also improves the soil pH of the moderately acidic soils if applied repeatedly over several seasons. It's a good source of K and N. Therefore, it is hoped that the use of FYM alone or in combination with fertilizers will gradually improve and sustain soil productivity over the years (Mwangi, 2010).

Potassium humate is an organic fertilizer which effects on plant growth and increase crop yield. Humic acid (HA) particularly is used to remove or decrease the negative effects of mineral fertilizers and some chemicals forms in the soil. So, humic substances have many beneficial effects on soil and consequently on plant growth and are shown highly hormonal activity. These materials not only increase macronutrients contents and ions uptake but also enhance micronutrients of the plant organs (Brunetti *et al*., 2005 and Kumar *et al.,* 2013). In addition, Montaser *et al*. (2011) reported that the humic acid (HA) may increase the permeability of plant membranes and enhance the uptake of nutrients. Moreover, HA may also improve soil nitrogen uptake and facilitate the uptake of potassium, calcium, magnesium and phosphorus, making these nutrients more mobile and available to plant root systems. Also, humic substances are organic substances of high molecular weights, and they are naturally widespread in aquatic and terrestrial environments. On the other hand, potassium is one of the essential nutrients required for plant growth and reproduction. In general, potassium plays an important role in many of the vital physiological process in the plant, such as transpiration, translocation of sugars and starch, protein formation and osmotic regulation (Basak, 2006).

Nitrogen is the most important essential nutrient for plant growth. It is a fertilizer in a balance and rational way to keep high and stable yield in important component of proteins, enzymes and vitamins in plant. It is a central part of the chlorophyll and essential photosynthetic molecule. The excessive application of mineral fertilizers led to increase production cost. The residual of mineral fertilizers has seriously affected the quality of agricultural products people's health and caused environmental pollution. Therefore a great interest has been generated to apply bioorganic and inorganic fertilizers to establish a good ecoenvironment (Basak, 2006). Nitrogen fertilizers are economically an expensive input. In many instances less than 60 %

of the added N is recovered in the (crop + soil) with the remainder being lost by processes such as volatilization, leaching, immobilization and denitrification. Thus, it is necessary to develop fertilizer management practices that can reduce losses and increase the nitrogen use efficiency (Yusron and Phillips, 1997).

Wheat plant (*Triticum aestivum L.*) is considered one of the most important cereal crops in the world. The mass production of wheat in Egypt (8 million ton) is about 50 % lower than the consumption (14.5 million ton / year at 2010). Therefore, more than six million tons must be imported annually. One or more of various manners should be followed. The first is by increasing the cultivated area of wheat in both old and newly reclaimed soils. The second is by growing resistant cultivars (plant certified must-free seed) which is considered the most economical and effective way of controlling diseases. The third is by improving agriculture practices among which are the time, irrigation and amount of chemical fertilization (Elbaalawy, 2010).

Therefore, the main targets of the current investigation are improvement of sandy soil characteristics (physical and chemical) and its highest productivity of wheat crop (quantity and quality) using FYM or K-humate individually and combination with mineral-N fertilization.

MATERIALS AND METHODS

A field experiment was carried out on sandy soil at the Farm of Ismailia Agric. Res. Station, Ismailia Governorate, Egypt (Latitude, 30^o 35' 41.901" N and longitude, 32^o 16' 45.834" E) during the two successive growing winter seasons, i.e., 2016 / 2017 and 2017 / 2018 on wheat plant (*Triticum aestivum L.*) variety Misr 1, to study the individual and combined effect of organic fertilizers (farmyard manure or potassium humate) and mineral nitrogen fertilization levels (0, 50, 75 and 100 kg N $fed.^{-1}$ as ammonium nitrate "33.5 % N") on plant growth, yield and its components as well as nutrient contents, apparent nitrogen recovery efficiency (ANRE) and agronomical efficiency, also on some chemical and physical properties of the studied soil. Application rates of farmyard manure (FYM) were 0 and 5 ton $fed.^{-1}$, while potassium humate at rates of 0 and 5 kg $fed.^{-1}$. The layout of the experiment was a split- plot design, with the main plots arranged in a randomized complete blocks design, with three replicates. The main plots were occupied with the organic fertilizers (farmyard manure or potassium humate) and sub-plots were assigned to mineral nitrogen fertilization levels. All agricultural practices beginning from preparation of soil to sowing until harvesting were carried out as recommended by Egyptian Ministry of Agriculture.

Before sowing, surface soil sample (0 - 30 cm) of the experimental soil was taken, air – dried, ground, sieved through a 2 mm sieve, kept and analyzed for some physical and chemical properties and its content of available macro- (N, P and K) and micro- (Fe, Mn and Zn) nutrients according to the methods described by Cottenie *et al*. (1982); Page *et al*. (1982) and Kim (1996). The obtained data were recorded in Table (1). Some chemical properties of farmyard manure and K-humate were determined according to methods described by Page *et al.* (1982) and data are presented in Tables (2 and 3).

The FYM and K-humate were applied thoroughly incorporated in the soil before sowing and good mixed with the surface soil of the experimental plots. Before sowing, all plots were fertilized with 100 kg /fed. of ordinary super phosphate (15.5 % P_2O_5), during the final soil preparation. Potassium fertilizer 24 kg K_2O / fed. was added as potassium sulphate (48 % K_2O) before the 1st irrigation. Nitrogen fertilizer at different rates were added in three equal doses of 15, 30 and 45 days after planting.

Table (1): Some physical, chemical and fertility characteristics of the studied soil.

characteristics	Value	characteristics	Value
Particle size distribution (%):		Soluble cations (soil paste mmolecL-1):	
Coarse sand	87.77	Ca2+	5.03
Fine sand	3.16		
Silt	3.22	Mg2+	1.83
Clay	5.85	Na+	7.18
Textural class Sandy		K+	1.28
Soil chemical properties:		Soluble anions (soil paste mmolecL-1):	
pH (1:2.5 soil water suspension)	7.77	CO3--	0.00
CaCO3 (g kg-1)	3.7	HCO3-	1.60
Organic matter (%)	0.40	Cl-	8.00
ECe (dS m-1, soil paste extract)	1.53	SO4--	5.72
CEC (cmolc kg-1 soil)	1.41	ESP	4.27
		SAR	3.88
Soil physical properties:			
Bulk density (g cm-3)	1.80	Wilting point (%)	0.71
Total porosity (%)	32.08		
Hydraulic conductivity (cm h-1)	39.70	Available water (%)	3.14
		Field capacity (%)	3.85

Available nutrients (mg kg-1)

N	P	K	Fe	Mn	Zn
35.87	7.3	52.3	4.10	2.55	0.70

Table (2) : Some composition of farmyard manure (FYM) used.

Characteristics	Value	Characteristics	Value
Bulk density (g/cm3)		Macronutrients	
Multiuser (%)	0.65	Total N (%)	0.90
pH*	12.00	Total P (%)	0.65
EC** (dS m-1)	7.23	Total K (%)	0.95
Organic matter (%)	2.76	NH4-N (mg kg-1)	36
Organic carbon (%)	19.94	NO3-N (mg kg-1)	193
Ash	11.50	Micronutrients (mg kg-1)	
C/N ratio	80.06	Total Fe	198
	13:1	Total Mn	120
		Total Zn	95

*Soil-water suspension 1: 5 **Soil water extract 1: 5

Table (3): Some composition of potassium humate (K-humate) used.

a) Typical analysis.

Humic acid	Moisture	pH (1%)	Water solubility	Appearance
70 %	15 %	9-10	90 %	Black

b) Organic and mineral components.

C	H	O	N	S
50 %	2 %	30 %	0.7 %	0.3 %

K2O	P2O5	Na	Ca	Mg	Fe
12 %	0.05 %	0.5 %	0.5 %	0.05 %	1500 mg/kg
Cu	Zn	Mn	Si	Mo	B
5 mg/kg	15 mg/kg	15 mg/kg	10 mg/kg	o.5mg/kg	200 mg/kg
Al	Cr	Pb	As	Hg	Cd
0.1%	10 mg/kg	15 mg/kg	5 mg/kg	1 mg/kg	1 mg/kg

c) Functional groups components.

Total acidity	Total carboxyl	Total hydroxyl	Total carbonyl	Phenolic hydroxyl	Alcoholic hydroxyl
588 cmol/kg	382 cmol/kg	195 cmol/kg	43 cmol/kg	126 cmol/kg	54 cmol/kg

The present experiment includes 36 experimental units (plots) including 12 treatments × 3 replicates. The area of each plot was 10.5m^2 (3.5 m length × 3 m width; 1/400 fed.). Wheat grains (Misr 1, cv.) were sown at 21st and 25th November during the first and second season respectively.

Just before harvesting, ten plants were taken randomly from each plot. Some growth parameters, i.e., plant height (cm), spike length (cm), number of tillers/ plant and number of grains/ spike. At harvesting time, the plants of each plot were harvested separately. The grains were separated from straw to measure: weight of 1000 grains (g), grains and straw yield as kg /fed. and were recorded. Biological yield (kg /fed.), harvest index (%) of wheat yield (grains) and agronomical efficiency were calculated. Grain and straw samples were air-dried then, oven-dried at 70 ^{o}C for 48 hrs., weighed, ground and digested for chemical determination according to the method described by Chapman and Pratt (1961). Nitrogen, P and K content in the digests were determined according to the methods described by Cottenie *et al.* (1982). Crude protein percentage was estimated in the different parts by multiplying N % values by 5.75 as described by A.O.A.C. (1990). The atomic absorption spectrophotometer was used to determine Fe, Mn and Zn concentrations in the prior parts according to the methods recommended by A. O. A. C. (1990). Apparent nitrogen recovery efficiency (ANRE) was calculated according to Quanbao *et al.* (2007). ANRE = {(uptake of N in treatment fertilized, kg fed.$^{-1}$ – uptake of N in control, kg fed.$^{-1}$) /quantity of N fertilizer applied (kg fed.$^{-1}$)}× 100.

After harvesting, surface soil samples (0 – 30 cm) were taken separately from

each experimental plot and prepared for some physical properties as prementioned. Also, available macro- (N, P and K) and micro- (Fe, Mn and Zn) nutrients according to the methods described by Cottenie *et al*. (1982); Page *et al*. (1982) and Kim (1996). The obtained data were recorded in Tables (10 and 11).

The data were exposed to statistical analysis according to Gomez and Gomez (1984). The significant differences among means were tested using the least significant differences (L.S.D.) at 5 % level of significant error.

RESULTS AND DISCUSSION

Growth Parameters:

The data presented in Table (4) showed the effect of nitrogen levels on some growth parameters of wheat plants i.e., plant height (cm), spike length (cm), number of tillers/ plant and number of grains/spike. The results revealed that, the maximum values of the previous growth parameters 118.0, 17.9, 3.7 and 50.1 were found in the treatment of 100 kg N fed^{-1} and minimum values 86.8, 9.3, 3.0 and 41.3 in the treatment of control, respectively. The relative increase (%) in the abovementioned parameters were 35.94, 92.47, 23.33 and 21.31, respectively, when compared with the control treatment without N addition. It could be noticed that all studied growth parameters significantly increased with increasing the nitrogen fertilizer levels. The increase in growth parameters combined with increasing nitrogen fertilization may be attributed to the role of nitrogen in improving the photosynthesis, increasing leaf area, meristematic activity which led to the increase in number of cells and cell elongation, consequently increasing the vegetative growth of wheat plants. These results are in harmony with those recorded by Tantawy *et al.* (2011); Shah *et al.* (2013) and Zakaria (2018).

Table (4): Some vegetative growth parameters of wheat plant as affected by the studied treatments.

Organic fertilizers	Rate of mineral N (kg fed. -1)	Plant height (cm)	Spike length (cm)	No. of tillers/ plant	No. of grains/spike
Without	0	86.8	9.3	3.0	41.3
	50	108.0	11.7	3.3	46.4
	75	115.0	14.2	3.3	47.8
	100	118.0	17.9	3.7	50.1
Mean		106.95	13.28	3.33	46.4
FYM (ton fed.-1)	0	100.2	12.3	3.7	48.7
	50	115.9	14.2	4.3	50.2
	75	120.6	17.8	4.3	51.6
	100	130.4	20.8	4.7	59.0
Mean		116.78	16.28	4.25	52.38
K-humate (kg fed.-1)	0	94.2	10.7	3.3	47.5
	50	112.0	12.8	3.6	48.7
	75	116.4	15.6	4.0	50.6
	100	119.5	19.5	4.3	54.2
Mean		110.53	14.65	3.83	50.25

L.S.D. at 5 % **Organic fertilizers: (A)** **Rate of mineral N: (B)** **Interaction: (A) × (B)**	**0.907** **1.047** **1.815**	**0.386** **0.445** **NS**	**0.506** **0.584** **NS**	**0.637** **0.793** **1.374**

Regarding to the effect of individual applications of either of FYM and K-humate on the four growth parameters of wheat plants presented in Table (4) may be noted that, comparing the data of control treatment (untreated plants), individual applications of FYM and K-humate causeed a significant increases of the estimated growth parameters i.e., plant height (cm), spike length (cm), number of tillers/ plant and number of grains/ spike. The found increases of the plant growth parameters as a result of FYM application alone were higher than those resulted from individual application of K-humate. The increases of these growth parameters as a result of FYM and K-humate may be attributed to their enhanced plant growth and nutrients uptake, in addition their improve effect on physical, chemical and biological soil properties and its content of available macro- and micro- nutrients. In this respect, El-Koumey *et al.* (2017) and Zakaria (2018) obtained on similar results. The superior increase effect of FYM application alone on the values of the estimated growth parameters compared with those resulted from the individual application of K-humate may be resulted from the greater effect of FYM application on the improve of soil properties and its content of available nutrients compared with these associated with the individual application of K-humate which resulted from the high content of essential plant nutrients in FYM compared with those in K-humate, except K content (Tables, 2 and 3).

The combination of organic materials and N fertilizers showed greater than the above mentioned parameters of plant growth than their sole application (Table, 4). The means regarding, i.e., plant height (cm), spike length (cm), number of tillers/ plant and number of grains/ spike, revealed that the highest values were 130.4, 20.8, 4.8 and 59.0 for plant height (cm), spike length (cm), number of tillers/ plant and number of grains/ spike, respectively which obtained with application of 5 ton FYM fed.$^{-1}$ combined with 100 kg N fed.$^{-1}$, while the values of the same growth parameters 119.5, 19.5, 4.2 and 54.2, respectively which observed with the treatment of 5 kg fed.$^{-1}$ potassium humate in the presence of 100 kg N fed.$^{-1}$. Humic substances have a very strong affected on the growth of wheat roots. When humic and fulvic acids and other humic substances added to the soil, enhancement of root initiation and increased root growth may be observed (Mikkelsen, 2005 and Abd El-Aal, 2018). Jones *et al.* (2007); Singh *et al.* (2013) and Zakaria (2018) concluded that application of humic acid and other organic manures (compost, FYM, humates……etc) improved growth parameters and promotes photosynthesis and transport assimilates of the carbohydrates to the storage organs of wheat and maize plants.

Yield and Its Components:

Data attained in Table (5) represent the values of wheat 1000-grain weight (g), grains, straw and biological yield (kg fed.$^{-1}$) as well as harvest index (%) and agronomical efficiency as effected by individual or combined treatments of N and organic fertilizers. These data reveals that, increasing rates of added mineral N fertilizers resulted in a significant increase of dry weight of both 1000-grain, grains, straw and biological yield. The relative increases over control, reached to 48.75, 208.33, 236.96 and

227.14 % for each 1000-grain weight, grains, straw and biological yield, respectively. These increases may be due to the nitrogen is one of the most important components of cytoplasm, nucleic acids and chlorophyll, so nitrogen has an important role in encouraging cell elongation, cell division and consequently increasing vegetative growth and activation of photosynthesis process which enhance the amount of the metabolites necessary for building plant organs which reflect increases in grain and straw yields. These increases were resulted from the enhanced effect of N fertilization on plant growth which early recorded from many studies (Basak, 2006; Tantawy *et al*., 2011 and Abd El-Kader, 2016).

In addition, the data in Table (5) showed that, the individual applications of either of FYM or K-humate were associated with an significant increases of 1000-grain weight (g), grains, straw and biological yield (kg fed.$^{-1}$) of wheat plants. The highest values of wheat 1000-grain weight (g) and grains yield (kg fed.$^{-1}$) were a resulted in K-humate application, while the highest yield of straw and biological yield were a resulted in FYM, under the same application rate of mineral N. These findings are in harmony with the chemical composition of both FYM and K-humate and its effect on plant growth and soil properties especially the content of available nutrients El-Koumey *et al.* (2017) and Zakaria (2018). The superior effect of K-humate application on the yield of grains and weight of 1000-grain compared with associated the treatment of FYM may be attributed to the high K content of K-humate compared with K content in FYM, where K encourages various enzymes and photosynthesis as well as plant root development which in turn resulted in higher dry matter accumulation in grains. Moreover K enhances translocation of metabolites synthesized from leaves to grains. Generally, K played a major role on grains formation and structure of cereal plants. Supportive evidences with these results were reported by (Marschner, 2003).

Table (5): Weight of 1000 grains, wheat yield (grains, straw and Biological), harvest index and agronomical efficiency as affected by the studied treatments.

Organic fertilizers	Rate of mineral N (kg fed. -1)	1000 grain weight (g)	Yield (kg fed.-1)			Harvest index (%)	Agronomical efficiency
			Grains	Straw	Biological		
Without	0	35.20	480.0	920.0	1400.0	34.29	0.00
	50	45.08	1200.0	2480.0	3680.0	32.61	14.40
	75	46.53	1320.0	2920.0	4240.0	31.13	11.20
	100	52.36	1480.0	3100.0	4580.0	32.31	10.00
Mean		44.75	1120	2355.0	3475.0	32.59	8.90
FYM (ton fed.-1)	0	42.33	677.2	1826.0	2503.2	27.06	0.00
	50	50.65	1400.0	2900.0	4300.0	32.56	14.45
	75	56.45	1440.0	3380.0	4820.0	29.88	10.17
	100	60.00	1780.0	4200.0	5980.0	29.77	11.03
Mean		52.49	1324.3	3076.5	4400.8	29.81	8.91
K-humate (kg fed.-1)	0	49.12	769.8	1710.0	2479.8	31.04	0.00
	50	55.40	1620.0	2560.0	4180.0	38.76	17.00
	75	57.15	1900.0	3000.0	4900.0	38.78	15.07
	100	61.45	2000.0	3560.0	5560.0	35.97	12.30
Mean		55.90	1572.45	2707.5	4279.95	36.14	11.09

L.S.D. at 5 %						
Organic fertilizers: (A)	**0.168**	**0.437**	**0.229**	**0.153**	**0.135**	**0.084**
Rate of mineral N: (B)	**0.194**	**0.505**	**0.265**	**0.177**	**0.156**	**0.097**
Interaction: (A) × (B)	**0.337**	**0.875**	**0.459**	**0.307**	**0.271**	**0.168**

Harvest index (%) = {grains yield (kg fed.-1) / biological yield (kg fed.-1) } × 100
Agronomical efficiency = {grain yield (fertilizer) – grain yield (control)} / applied nitrogen

Concerning the interaction between organic fertilizers (FYN or K-humate) and mineral N fertilizers levels significant increases of yield and yield components of wheat plants. Data in Table (5) revealed that the maximum values for 1000-grain weight (g) and grains yield were obtained under treatment by 100 kg N fed.$^{-1}$ + K-humate ,while the maximum values for straw and biological yield were obtained under treatment by 100 kg N fed.$^{-1}$+ FYM. The relative increases for FYM over control (N- fertilizer at rate 0, 50, 75 and 100 kg N / fed. and without FYM), reached to 20.26, 12.36, 21.32 and 14.59 of 1000-grain weight, 41.08, 16.67, 9.09 and 110.27 of grain yield and 98.48, 16.94, 15.75 and 26.19 % of straw, respectively. On the other hand, The relative increases for K-humate over control (N- fertilizer at rate 0, 50, 75 and 100 kg N / fed. and without K-humate), reached to 39.55, 22.89, 22.82 and 17.36 of 1000-grain weight, 60.38, 35.00, 43.94 and 35.14 of grain yield and 85.87, 3.23, 2.74 and 14.84 % of straw, respectively.

Under different fertilization treatments in this study, the yield of grains were lower than those of straw. So, the calculated values of harvesting index (HI, %) were lower than 40 %. The highest values of HI (38.78, %) were recorded with the treatment by 75 kg N fed.$^{-1}$ plus 5 kg fed.$^{-1}$ K-humate. Dileep *et al.* (2014); Abd El-Kader (2016) and El-Koumey *et al.* (2017) reported such beneficial effect of different plant species.

Agronomical efficiency (AE) of N fertilizer may be used as a good parameter to estimate the efficiency of each fertilizer unit in grains production. Data in Table (5) showed that, individual applications of N fertilizer, the highest AE value (14.40) was found with the grains of wheat plants received 50 kg N fed.$^{-1}$ and decreased with the increase rate of added N. With the three rates of added N alone, AE values were positive with wide variation from rate to another. Recently, El-Tahlawy (2018) and Zakaria (2018) obtained similar results with wheat and maize plants respectively, under sandy soil conditions.

In addition, N additions at different levels, i.e., 50, 75 and 100 kg fed.$^{-1}$ in combination with either of FYM or K-humate were associated with a significant increases of AE of N fertilizer on grains yield compared with the individual applications of N (Table, 5), where the increases of AE for grains of wheat plants fertilized by K-humate were higher than those result from FYM applications at the same rate of added N. These findings are in harmony with the effect of the studied treatment on grain yield and K content in the used organic fertilizers. These results are in agreement with those obtained by Dileep *et al.* (2014); Abd El-Kader (2016) ; El-Koumey *et al.* (2017) and Zakaria (2018).

Nutrients Concentration in Grains and Straw of Wheat plants:

Data presented in Tables (6 and 7) showed that, N application alone at different levels slightly increased concentration of the studied macro- (N, P and K, %) and micronutrients (Fe, Mn and Zn, mg kg^{-1}) in grains and straw of wheat plants, where these concentrations were increased with the increase of rate applied N-levels. This may be due to high availability of the nutrients with increase in the fertilizer application (N) which

ultimately resulted in better root growth and increased physiological activity of roots to absorb the nutrients (Tantawy *et al.,* 2011; Abd El-Kader, 2016 and Zakaria, 2018).

In addition, individual applications of either both FYM or K-humate to sandy soil resulted in a significant increases of N, P, K, Fe, Mn and Zn concentration in the grains and straw of wheat plants (Tables, 6 and 7). At the same individual treatments of N-fertilizer, FYM and K-humate, grains concentrations of the estimated macro- and micronutrients and protein were higher than those found in the straw. The increases effect of FYM and K-humate application alone attributed to the presence of nutrients in the added organic fertilizers and also to its effect on the soil content of available nutrients (Verlinden *et al*., 2009 and Nassar and Abd El-Rahaman, 2015). Except K concentration (%), N, P, Fe, Mn and Zn concentration (%) in both grains and straw of wheat plants received FYM alone were higher than those found in the plants received K-humate. These findings were resulted from the high content of K in K-humate compared with that in FYM.

The combined treatments application of N at different levels with either of FYM or K-humate were associated with clear and significant increases of N, P, K, Fe, Mn and Zn concentration in both grains and straw of wheat plants compared with any individual application of N, FYM and K-humate (Tables, 6 and 7), where the highest concentrations of these nutrients in grains and straw, were found with 100 kg N fed.$^{-1}$ plus FYM followed by those found with 100 kg N fed.$^{-1}$ plus K-humate, except K concentration which appeared high values K-humate application as a result of high content of K in K-humate compared with that in FYM. These findings are in agreement with those obtained by Nassar and Abd El-Rahaman (2015); Abd El-Kader (2016) and Zakaria (2018). Generally, at the same treatment, it was found that content of N and P in the grains is higher than straw while the K content in straw is higher than grains.

Table (6): Macronutrients (N, P and K), micronutrients (Fe, Mn and Zn) concentration and crude protein in grains of wheat plant as affected by the studied treatments.

Organic fertilizers	Rate of mineral N (kg fed. -1)	Macronutrients (%)			Micronutrients (mg kg-1)			Crude protein (%)
		N	P	K	Fe	Mn	Zn	
Without	0	1.32	0.30	0.76	70.95	40.20	21.9	7.59
	50	1.33	0.33	0.78	72.38	42.62	22.3	7.65
	75	1.35	0.35	1.13	73.00	43.23	23.2	7.76
	100	1.38	0.39	1.24	75.20	44.75	24.1	7.94
Mean		1.34	0.34	0.98	72.88	42.7	22.88	7.74
FYM (ton fed.-1)	0	1.55	0.33	0.91	76.12	46.15	23.5	8.91
	50	1.67	0.38	1.07	80.94	49.23	25.0	9.60
	75	1.85	0.42	1.18	82.94	50.57	26.9	10.64
	100	1.92	0.46	1.29	85.15	54.34	30.3	11.04
Mean		1.75	0.40	1.11	81.29	50.07	26.43	10.05
K-humate (kg fed.-1)	0	1.41	0.31	1.12	73.46	43.50	22.7	8.11
	50	1.54	0.35	1.20	76.87	47.64	24.2	8.86
	75	1.63	0.38	1.25	79.63	48.89	25.0	9.38
	100	1.77	0.41	1.32	80.44	50.14	27.4	10.18

Mean	**1.59**	**0.36**	**1.22**	**77.6**	**47.54**	**24.83**	**9.13**
L.S.D. at 5 %							
Organic fertilizers: (A)	**0.032**	**0.190**	**0.032**	**0.191**	**0.084**	**1.400**	**0.557**
Rate of mineral N: (B)	**0.037**	**0.022**	**0.037**	**0.220**	**0.097**	**1.620**	**0.643**
Interaction: (A) × (B)	**0.064**	**N.S**	**0.064**	**0.382**	**0.168**	**2.800**	**1.115**

Table (7): Macronutrients (N, P and K), micronutrients (Fe, Mn and Zn) concentration and crude protein in straw of wheat plant as affected by the studied treatments.

Organic fertilizers	Rate of mineral N (kg fed. -1)	Macronutrients (%)			Micronutrients (mg kg-1)			Crude protein (%)
		N	P	K	Fe	Mn	Zn	
Without	0	1.03	0.20	0.83	50.1	22.3	15.25	5.92
	50	1.11	0.23	0.98	53.4	25.4	16.30	6.38
	75	1.13	0.25	1.20	56.7	28.2	18.00	6.50
	100	1.17	0.28	1.27	58.1	28.8	19.29	6.73
Mean		1.11	0.24	1.07	54.58	26.18	17.21	6.38
FYM (ton fed.-1)	0	1.15	0.27	1.17	57.6	28.1	19.89	6.61
	50	1.20	0.30	1.19	59.8	29.6	20.96	6.90
	75	1.30	0.32	1.28	61.2	31.2	21.31	7.49
	100	1.40	0.36	1.32	62.7	32.6	21.63	8.05
Mean		1.26	0.31	1.24	60.33	30.38	20.95	7.26
K-humate (kg fed.-1)	0	1.11	0.24	1.31	55.2	26.2	18.22	6.38
	50	1.19	0.26	1.36	58.1	27.4	20.16	6.84
	75	1.22	0.29	1.40	60.0	29.7	20.48	7.02
	100	1.24	0.33	1.49	60.5	30.9	20.55	7.13
Mean		1.19	0.28	1.39	58.45	28.55	19.85	6.84
L.S.D. at 5 %								
Organic fertilizers: (A)		0.034	0.027	0.032	0.803	0.027	0.191	0.191
Rate of mineral N: (B)		0.039	0.031	0.037	0.928	0.031	0.336	0.220
Interaction: (A) × (B)		0.068	N.S	0.064	1.607	0.054	0.382	0.382

Crude Protein (%):

The crude protein (%) in grains and straw of wheat plants increased significant with increase individual application rate of mineral N and also as a result of individual application of FYM and K-humate, where the high protein content was found with the individual application of N at rate of 100 kg fed.$^{-1}$ compared with the individual application of FYM and K-humate (Tables, 6 and 7). Individual application of FYM resulted in a more increase of wheat plants (grains and straw) content of protein compared with that found in the plants fertilized by K-humate. These findings are in harmony with the chemical composition of the added the organic fertilizers, especially the content of N. These results are in agreement with those obtained by Nassar and Abd El-Rahaman (2015); Abd El-Kader (2016) and Zakaria (2018).

Data in Tables (6 and 7) show a significant increases of wheat plants (grains and straw) content (%) of protein followed by N + FYM and N+ K-humate applications together compared with those associated with the individual treatments of these. Generally, the

highest content of protein was found in the wheat plants (grains and straw) received 100 kg N fed.$^{-1}$ plus FYM followed by that found in the plants fertilized with 100 kg N fed.$^{-1}$ plus K-humate. Also, at the same treatment of N, FYM and K-humate alone or together, protein content of grains was higher than that found in the straw. In this respect, Nassar and Abd El-Rahaman (2015) ; Abd El-Kader (2016) and Zakaria (2018) obtained similar results.

Nutrients Uptake in Grains and Straw of Wheat Plants:

The effect of various nitrogen fertilizers, i.e., FYM and K-humate on macro- (N, P and K) and micro- (Fe, Mn and Zn) nutrients uptake in grains and straw as well as apparent nitrogen recovery efficiency (ANRE) of wheat plants are presented in Tables (8 and 9). Individual applications of N were associated with a significant increases of the determined macro- and micro-nutrients uptake by grains and straw of wheat plants. These increases resulted from the enhanced effect of N fertilizer on obtained dry matter yields of grains and straw as aforementioned by Elbaalawy (2010); Tantawy *et al.* (2011) Abd El-Kader (2016) and Zakaria (2018). Similar increases of macro- and micronutrients uptake by grains and straw of wheat plants were found as a result of FYM or K-humate applications alone, where the found increases in the plants received FYM were higher than those found in the plants fertilized by K-humate , except K uptake which appeared high uptake in the plants fertilized by K-humate. The found increases of nutrients uptake by wheat plants fertilized by FYM and K-humate attributed to their effect on plant growth and soil content of available nutrients as mentioned before that by Nassar and Abd El-Rahaman (2015) ; Abd El-Kader (2016) and Zakaria (2018).

Table (8): Macronutrients (N, P and K), micronutrients (Fe, Mn and Zn) uptake and apparent nitrogen recovery efficiency (ANRE) in grains of wheat plant as affected by the studied treatments.

Organic fertilizers	Rate of mineral N (kg fed. -1)	Macronutrients (kg fed.-1)			Micronutrients (g fed.-1)			ANRE
		N	P	K	Fe	Mn	Zn	
Without	0	6.34	1.44	3.65	340.56	192.96	105.14	----
	50	15.96	3.96	9.36	868.56	511.44	267.6	19.24
	75	17.82	4.62	14.92	963.6	570.63	306.23	15.31
	100	20.42	5.77	18.35	1112.96	662.31	356.68	14.08
Mean		15.14	3.95	11.57	821.42	484.37	258.91	12.16
FYM (ton fed.-1)	0	10.49	2.23	6.16	515.48	312.52	159.14	----
	50	23.38	5.32	14.98	1133.16	689.22	350.00	25.78
	75	26.64	6.05	16.99	1194.34	728.15	387.36	21.53
	100	34.18	8.19	22.96	1515.67	967.25	539.34	23.69
Mean		23.67	5.45	15.27	1089.66	674.29	358.96	17.75
K-humate (kg fed.-1)	0	10.85	2.39	8.62	565.49	334.91	174.74	----
	50	24.94	5.67	19.44	1245.3	771.77	392.04	28.18
	75	30.97	7.22	23.75	1512.97	928.91	475.00	26.83
	100	35.67	6.20	26.40	1608.8	1002.80	548.0	24.82
Mean		25.61	5.87	19.55	1233.139	759.60	397.45	19.96

L.S.D. at 5 %							
Organic fertilizers: (A)	0.519	0.289	0.386	0.474	0.474	0.038	0.790
Rate of mineral N: (B)	0.599	0.334	0.445	0.011	0.011	0.508	0.912
Interaction: (A) × (B)	1.038	0.578	0.772	0.948	0.329	0.076	1.580

Table (9): Macronutrients (N, P and K), micronutrients (Fe, Mn and Zn) uptake and apparent nitrogen recovery efficiency (ANRE) in straw of wheat plant as affected by the studied treatments.

Organic fertilizers	Rate of mineral N (kg fed. -1)	Macronutrients (kg fed.-1)			Micronutrients (g fed.-1)			ANRE
		N	P	K	Fe	Mn	Zn	
Without	0	9.47	1.84	7.64	460.92	205.16	140.30	----
	50	27.53	5.37	24.30	1324.33	629.92	404.24	36.12
	75	33.00	7.30	35.04	1655.64	823.44	525.61	31.37
	100	36.26	8.68	39.40	1801.44	892.72	598.04	26.79
Mean		26.57	5.80	26.59	1310.58	637.81	417.05	23.57
FYM (ton fed.-1)	0	21.00	4.93	21.36	1051.78	513.11	363.20	----
	50	34.80	8.70	34.51	1733.92	858.40	607.84	27.60
	75	34.94	10.82	43.27	2068.55	1054.56	720.30	18.59
	100	58.79	15.11	55.44	2633.42	1369.16	908.49	37.79
Mean		39.64	9.89	38.65	1871.92	948.81	649.98	21.00
K-humate (kg fed.-1)	0	18.98	4.08	22.40	943.91	448.02	313.52	----
	50	30.46	6.66	34.82	1487.36	701.44	516.09	22.96
	75	36.60	8.70	42.00	1800.00	891.00	614.6	23.49
	100	44.15	11.75	53.04	2153.73	1100.04	727.91	25.17
Mean		32.55	7.80	38.06	1596.25	785.13	542.90	17.91
L.S.D. at 5 %								
Organic fertilizers: (A)		0.923	0.973	1.075	0.639	0.837	0.100	N.S
Rate of mineral N: (B)		1.065	0.754	1.240	0.749	0.740	0.198	0.314
Interaction: (A) × (B)		1.846	0.947	2.151	0.278	0.675	0.200	0.472

Data in Tables (8 and 9) also show that, combined applications of N + FYM and N+ K-humate resulted in a significant increases of macro- and micronutrients uptake by grains and straw of wheat plants compared the individual applications of these three fertilizers. The found increases of nutrients uptake in the plants fertilized by N + FYM were higher than those found in the plants received N + K-humate , except K uptake. In general under different studied treatments, nutrients uptake by straw were higher than those uptake by grains. Soliman (2007); Verlinden *et al.* (2009) and Abd El-Kader (2016) found similar results with different organic fertilizers.

Data illustrated in Tables (8 and 9) show that, apparent nitrogen recovery efficiency (ANRE) was defined as the ratio of total content of nitrogen (uptake) in plants receiving different treatments minus total content of nitrogen (uptake) without treatments application (control), then divided by nitrogen application as kg fed. $^{-1}$ is then multiplied by one hundred. Results indicate that

application of both organic and mineral N fertilizers to the soil increased apparent nitrogen recovery efficiency as compared to control treatments, and the applied high rate was superior compared to the low one. With regard to the different treatments, results indicated that the highest values of (ANRE) in grains for wheat plants were recorded in case of applying K-humate as compared to FYM and mineral fertilizer, while the highest values of (ANRE) in straw for wheat plants were recorded in case of applying mineral fertilizer as compared to FYM and K-humate, high rates were more beneficial. As for the effect of mineral and organic (FYM and K-humate) fertilizers, data indicate that, for both studied seasons, the application of all fertilizers significantly increased (ANRE) as compared to control. The treatments of fertilizers may be generally arranged as follows: K-humate > FYM > mineral fertilizer, in grains while arranged as follows: mineral fertilizer > FYM >K-humate, in straw. The same trend was observed with all fertilizers application in two successive seasons. In this connection, Quanbao *et al.* (2007) and Mwangi (2010) obtained similar results.

Soil Content of Available Macro- and Micronutrients:

The soil contents of available macro- i.e., N, P and K (kg fed.$^{-1}$) and micronutrients, i.e., Fe, Mn and Zn (g fed.$^{-1}$) affected by the studied treatments as listed in Table (10) show that, the soil content of available nutrients were decreased with the increase rate of added N fertilizer individually, except the content of available N which recorded small increases as a result of N application. In this respect, Tantawy *et al.* (2011) obtained similar results with rice plants fertilized by different forms of mineral nitrogen fertilizers. The decreases in the soil content of available P, K, Fe, Mn and Zn after harvesting of wheat plants fertilized by ammonium nitrate at rates of 50, 75 and 100 kg fed.$^{-1}$ attributed to the high uptake of these nutrients by wheat plants received N fertilizer. These decreases were increased with the increase rate of added N.

Individual applications of FYM or K-humate were associated with an increases of sandy soil content of available N, P, K, Fe, Mn and Zn (Table, 10), where the found increases of these contents as a result of FYM application were higher than those associated with the treatment of K-humate, except the soil content of available K which takes reversible trend. The application of FYM increased of P content, and possibly by increasing retention of P in soil. A positive effect of FYM on P availability was also noticed by Roy *et al.* (2001). Lal *et al.* (2000) reported that with the increase in incubation time the K mineralized increased significantly and raised the available K in soil due to release of more of organically bound potassium in course of decomposition of organic waste. Vaughan and Ord (1991) found that inhibition of urease activity by humic acid led to reduced N losses thereby increase N concentration in soil. Hua *et al.* (2008) reported that humic substances in soil can decrease P fixation and increase the P uptake of plants. Similarly, the increased soil available K observed may be attributed to the reduced K fixation as well as release of fixed K by humic acid.

Finally, data in Table (10) show that, the combined applications of N + FYM and N + K-humate appeared a wide variations in their effects, on sandy soils content of available N, P, K, Fe, Mn and Zn, where these application resulted in a slight increase of the soil content of

available nutrients compared with these resulted from the individual applications of FYM and K-humate. At the same application rate of N, sandy soil fertilized by FYM have a high content of available N, P, Fe, Mn and Zn. On the other hand, the high soil of available K was found in the soil received K-humate. Senn (1991) revealed that humateas natural organic substances high in trace elements necessary for development of plant life and soil health. Further humic acid binds to soil colloidal surfaces, promotes heavy metal absorption (Zn, Mn, Cu, Fe) to soil minerals and enhance their availability. Govindasamy and Chandrasekaran (2002) reported that the application of humic acid increases the concentration in soil and enhance the uptake of Fe, Mn and Zn by rice. Moharanaa *et al.* (2017) found the importance of application of FYM in improving soil properties and maintaining micronutrients availability in soil and their uptake by wheat for sustainable crop production. In this respect, similar results were obtained by Elbaalawy (2010); Abd El-Kader (2016) ; El-Koumey *et al.* (2017) and Zakaria (2018) with many sources of organic fertilizers.

Table (10): Macronutrients (N, P and K) and micronutrients (Fe, Mn and Zn) content in sandy soil as affected by the studied treatments, after wheat plants harvesting.

Organic fertilizers	Rate of mineral N (kg fed. -1)	Available macronutrients (kg fed.-1)			Available micronutrients (g fed. -1)		
		N	P	K	Fe	Mn	Zn
Without	0	11.68	1.90	51.50	3.98	2.50	0.65
	50	13.20	1.80	51.15	3.90	2.40	0.60
	75	14.10	1.68	50.70	3.65	2.22	0.53
	100	15.70	1.50	50.20	3.50	2.05	0.50
Mean		13.67	1.72	50.89	3.76	2.29	0.57
FYM (ton fed.-1)	0	13.10	2.18	53.81	4.82	2.80	0.85
	50	13.65	2.15	53.40	4.70	2.75	0.81
	75	15.35	2.10	52.75	4.45	2.68	0.76
	100	16.18	2.05	52.33	4.28	2.59	0.72
Mean		14.75	2.12	53.07	4.56	2.71	0.79
K-humate (kg fed.-1)	0	12.95	2.10	56.75	4.61	2.68	0.80
	50	13.30	2.10	56.05	4.50	2.66	0.77
	75	14.65	2.06	55.25	4.35	2.60	0.73
	100	15.98	2.02	54.10	4.18	2.58	0.70
Mean		14.22	2.07	55.54	4.41	2.63	0.75

L.S.D. at 5 %						
Organic fertilizers: (A)	0.077	0.053	0.395	0.161	0.047	0.028
Rate of mineral N: (B)	0.089	0.062	0.342	0.186	0.054	0.033
Interaction: (A) × (B)	0.155	0.107	0.684	0.322	0.095	0.057

Soil Bulk Density, Total Porosity and Its Content of Organic Matter:

The presented data in Table (11) show that, the soil content of organic matter "OM" (%) was slightly decreased as a result of different application rates of N fertilizer either alone or together with FYM and K-humate. For example the soil content of OM was decreased from 0.39 % in unfertilized soil to 0.37 % in the soil received 100 kg N fed.$^{-1}$. These decreases in the soil content of OM as a result of N applications attributed to activation effect of N on the biological activity which played a major role on the increase decomposition rate of soil organic matter. On the other hand, individual application of FYM and K-humate resulted in a slight increase in the soil content of OM with the superior increase effect of FYM application compared with that resulted from K-humate application. This trend may be resulted from the high stable of OM presented in FYM compared with that in K-humate. Before that, Senn (1991); Seddik (2006) and Shah *et al.* (2013) obtained similar results.

Table (11): Bulk density (g cm-3), total porosity (%) and organic matter (%) in sandy soil as affected by the studied treatments, after wheat plants harvesting.

Organic fertilizers	Rate of mineral N (kg fed. -1)	Bulk density (g cm-3)	Total porosity (%)	Organic matter (%)
Without	0	1.80	32.08	0.39
	50	1.80	32.08	0.39
	75	1.83	30.94	0.37
	100	1.85	30.19	0.37
Mean		1.82	31.32	0.38
FYM (ton fed.-1)	0	1.65	37.74	0.46
	50	1.70	35.85	0.44
	75	1.72	35.09	0.44
	100	1.78	32.83	0.42
Mean		1.71	35.38	0.44
K-humate (kg fed.-1)	0	1.70	35.85	0.45
	50	1.72	35.09	0.42
	75	1.78	32.83	0.42
	100	1.80	32.08	0.40
Mean		1.75	33.96	0.42

L.S.D. at 5 %			
Organic fertilizers: (A)	**0.025**	**0.145**	**0.017**
Rate of mineral N: (B)	**0.029**	**0.168**	**0.019**
Interaction: (A) × (B)	**0.051**	**0.291**	**0.034**

Real density = 2.65 g cm-3

Data of soil bulk density (g cm^{-3}) and total porosity (%) in relation with the studied treatments as listed in Table (11) may be summarized in the following points: 1- Increasing rate of added N fertilizer alone and in together were associated with a slight increase of soil bulk density and increased its total porosity which resulted from the decrease in the soil content of organic matter at different rates of added N, 2- Individual application of FYM and K-humate resulted in a decrease of soil bulk density and increased total porosity which resulted from the aggregation effect of these organic matter, where the found decrease in soil bulk density and increased total porosity resulted from FYM application were higher than those resulted from K-humate application, also this trend is in harmony with the effect of these treatments on the soil content of OM , and 3- The combined applications of N+FYM and N+K-humate decreased soil bulk density and increased total porosity compared with those in the control treatment and individual applications of N , but have high decrease of soil bulk density and low porosity compared with the individual applications of either FYM or K-humate. These results are in agreement with those obtained by Mikkelsen (2005) ; Dileep *et al.* (2014) and Moharanaa *et al.* (2017).

Conclusion:

From the abovementioned results it could be concluded that, FYM and K-humate as soil fertilizers enhanced the soil physical and chemical properties and may be the bedding materials of root zone area as well as, to some extent, the availability of nutrients in soil which positively reflected on the productivity (quantities and quality) of wheat plants, under sandy soil condition. The best treatment with regard to improving soil properties as well as increasing wheat (grains and straw) yield and nutrients uptake was the combined treatment of 100 kg N $fed.^{-1}$ + FYM followed by 100 kg N $fed.^{-1}$ + K-humate.

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تحسين خواص الأرض الرملية و إنتاجيتها من القمح بإستخدام التسميد العضوي والنيتروجين المعدني

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الملخص العربي

أُجريت تجربة حقلية علي الأرض الرملية في محطة البحوث الزراعية بالإسماعيلية – محافظة الإسماعيلية – مصر، خلال موسمي نمو شتاء متتاليين 2016 / 2017 و 2017 / 2018 م علي نبات القمح صنف مصر 1، لدراسة التأثير المنفرد و المشترك لإستخدام الأسمدة العضوية (السماد البلدي أو هيومات البوتاسيوم) و مستويات مختلفة من التسميد النيتروجيني المعدني (صفر، 50، 75 و 100 كجم ن/فدان، علي صورة سماد نترات الأمونيوم التي بها ن 33,5 ٪) علي نمو النبات و المحصول و مكوناته و كذلك محتواه من المغذيات و الكفاءة المحصولية و أيضاً تأثير هذه المعاملات علي بعض الخواص الكيميائية و الطبيعية للأرض تحت الدراسة. وقد تم إضافة السماد البلدي بمعدلات صفر و 5 طن / فدان ، بينما تم إضافة هيومات البوتاسيوم بمعدلات صفر و 5 كجم / فدان. و قد صُممت التجربة بنظام قطع منشقة في ثلاث مكررات.

و لقد أوضحت نتائج الدراسة وجود زيادة معنوية في جميع مقاييس النمو مثل طول النبات (سم) ، طول السنبلة (سم)، عدد التفرع / نبات ، عدد الحبوب / سنبلة وكذلك محصول الحبوب و القش و المحتوي (سواء كان التركيز أو الممتص) من المغذيات الكبري (نيتروجين ، فوسفور و بوتاسيوم) و الصغري (حديد، منجنيز و زنك) نتيجة لإضافات النيتروجين المعدني و السماد البلدي أو هيومات البوتاسيوم ، منفردة أو مجتمعة. ولقد سجلت المعاملة المزدوجة للنيتروجين المعدني و السماد البلدي أعلي القيم لجميع القياسات و التقديرات السابقة ، تلاها في ذلك المعاملة المزدوجة للنيتروجين المعدني و هيومات البوتاسيوم وذلك بإستثناء محصول الحبوب و وزن 1000 حبة و المحتوي من البوتاسيوم حيثُ سجلت أعلي قيم لهم مع المعاملة المزدوجة للنيتروجين المعدني و هيومات البوتاسيوم. بالإضافة إلي ذلك فقد صاحب الإضافات المنفردة للنيتروجين المعدني نقصاً في محتوي الأرض من المغذيات الميسرة الكبري (الفوسفور و البوتاسيوم) و الصغري (حديد، منجنيز و زنك). ومن ناحية أخري، فقد إزداد محتوي الأرض من هذه المغذيات الكبري و الصغري الميسرة نتيجة للإضافات المنفردة للسماد البلدي و هيومات البوتاسيوم مع وجود تفوق في زيادة هذا المحتوي مع معاملات السماد البلدي مقارنة بالزيادة المصاحبة لمعاملة هيومات البوتاسيوم و ذلك بإستثناء محتوي الأرض من البوتاسيوم الميسر. كما تناقص محتوي الأرض من المادة العضوية كنتيجة لزيادة المضاف من النيتروجين بينما إزداد هذا المحتوي مع الإضافات المنفردة لكلٍ من السماد البلدي و هيومات البوتاسيوم. ولقد زادت الكثافة الظاهرية للأرض المسمدة بالنيتروجين منفرداً بينما تناقصت هذه القيم مع الإضافات المنفردة لكلٍ من السماد البلدي و هيومات البوتاسيوم.

وطبقاً للنتائج المتحصل عليها، فإنه تحت ظروف الأراضي الرملية فإن الأسمدة العضوية تلعب دوراً رئيساً في زيادة خصوبة و إنتاجية هذه الأرض من القمح وتُصبح هذه الأسمدة أكثر فاعلية و كفاءة عند إضافتها مع السماد النيتروجيني المعدني.

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