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Effect of Potassium Humate and Bentonite on some Soil Chemical Properties under Different Rates of Nitrogen Fertiliztion

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ABSTRACT

A field experiment was carried out at Ismailia Agric. Res. Station, ARC during the successive winter growing seasons of 2015 and 2016. Wheat crop (*Triticum aestivum* L,) was cultivated under sprinkler irrigation system to study the effect of soil amendments (bentonite and potassium humate) on soil chemical properties of sandy soil, under different nitrogen doses (100, 75 and 50% N), along with wheat productivity and nutrients uptake. Results revealed no significant effect of mean pH values of different treatments compared to control. Conversely of results indicated increases of OM and CEC under effect of either bentonite or potassium humate; no significant effect was obtained among rates of nitrogen. Results, generally, showed positive responses of available N, P and K compared to control treatments. Finally, results revealed significant positive responses of total yield (straw and grains) along with total content of nutrient elements. From the present study, soil conditioner (combination of bentonite and potassium humate) was favorable for soil parameters of chemical soil properties of sandy soil which reflects on increase soil fertility. Use of 75 or 50 % N rates instead, of 100% N, being suggested whose difference was not significant

Keywords: bentonite, potassium humate, chemical soil properties, plant growth and wheat crop.

INTRODUCTION

Sandy soils exist on a large scale in the world, it has to be cultivated. Therefore, it should be raise the fertility increase by adding soil amendments either organic or natural inorganic, which is reflected on the improvement of physical and chemical properties

The coarse textured soils, due to their low content of clay, are infertile because they usually contain little humus, nutrients and water. (Croker, *et al*., 2004). Therefore, sandy soils are characterized by very low fertility and water holding capacity (Goa, *et al*., 1998), and a very limited microbial activity (Morsli, *et al*., 2004). This low fertility is one of the constraints in this region of limiting agricultural production mainly cereals which require improvement by industrial fertilizers to increase crop yields. Therefore, the technical means to improve the nitrogen content of these soils are limited due to the low presence of clay, and improper physico-chemical conditions and mineral nutrition of wheat (Le Houerous, 1993).

Thus, the important step in the process of improving soil chemical characteristics of these degraded soils is to address the problem of declined nutrient and cation holding capacity (i.e., CEC) associated with a reduction in soil organic matter. A possible approach to remediating the fundamental exchange properties of these degraded soils may reside in the use of natural materials or industrial waste products, both of which could represent cost to the farmer. Ideally, improvement of soil would include improvements for both the chemical and physical characteristics. (Croker, *et al*., 2004)

In this perspective, introducing clay-rich bentonite can improve the physical and chemical characteristics of these soils. This action will increase cation exchange capacity (Deiou, 1987), and improve soil structure leading to good water and nutrients retention and better soil ventilation (Raimund and Dietmar 1996). Aleem *et al*., (2000) suggested that added bentonite to sand soil allow to improvement of the physical, chemical and hydrous characteristics on account of high capacity to keep back the water and its strong exchange cationic capacity and thus to increase the agricultural yield. A further benefits of bentonite its capacity to increase plant available water (PAW) as a function of increasing porosity (Soda *et al*., 2006).

In order to complete the vision to improve the properties of sandy soil, add of organic conditioner such as potassium humate. Khaled and Fawy (2011) found that humic acids are an important soil component that can improve nutrient availability and impact on other important physical, chemical and biological properties of soils. Humic substances have started to be given to soil in Egypt and other parts of the world as to improve the crop yield. Gümü and Seker (2015) pointed out that HA (humic acid) applications at the rate of 4% significantly increased both mean soil total nitrogen content and aggregate stability after three incubation periods ($p < 0.05$); HA has the potential to improve the structure of soil in short term.

Foliar application of organic fertilizers can supply nutrients more rapidly than methods involving root uptake which made the local growers use foliar fertilizers to supplement soil applied nutrients and compensate for decreased root activity. Humic substances may be absorbed by the roots and transported to shoots, thus enhancing the growth of the whole plant (Shahein *et al*., 2015). Humic substances may be classified into three categories; humic acid, fulvic acid and humin (Solange and Rezende, 2008). Potassium humate is the salt of humic acid and water soluble. Humic acid influences the plant growth both directly and indirectly; the indirect effect of humic acid is improvement of physical, chemical and biological conditions of soil. Its direct effects are attributed to effect on metabolic activity in plant growth (Tejada *et al*., 2006). Therefore when plants were treated with potassium humate, chlorophyll contents were increased. Also, entering in plant cell, the functional group of humic and fulvic acids can serve as supplementary source of respiratory catalysts. (Ryosuke *et al*., 2006)

Bacilio *et al*., (2003) found that potassium humate act a humic acid applied in proper concentrations may be able to enhance root growth. Fong *et al*., (2007). Decided that humic acid can be produced an availability to be in the form of inexpensive soluble salts, referred to as potassium humate. Gadimov *et al*., (2007). Added that potassium humate causes an increase in crop quality and tolerance of plant to drought, saline, cold, diseases and pests stresses The goal of this research was to evaluate chemical properties of the sandy soil under the influence of each of the bentonite and potassium humate along with nitrogen rates, all being reflected on the increase of sandy soil fertility and thus reduce the required nitrogen fertilizer, in addition to improving the productivity of grown wheat crop.

MATERIALS AND METHODS

A field experiment was carried out at Ismailia Agric. Res. Station, ARC during the successive winter growing seasons of 2015 and 2016. Wheat crop (*Triticum aestivum* L,) was cultivated under sprinkler irrigation system to study the effect of soil amendments (bentonite and Potassium humate) on soil chemical properties of sandy soil, using nitrogen doses (100, 75 and 50% N), wheat productivity and nutrients uptake being also evaluated. The institute farm is located at 30° 35´41.9" N Latitude and 32° 16´ 45.8" E longitude. The soil under study was analyzed according to methods described by Cottenie *et al*., (1982) as shown in Table (1); relative chemical properties of bentonite and potassium humate are described in Tables (2 and 3). The experiment was designed in a randomized complete block design with three replications.

Table 1. Physical and chemical properties of the experimental soil

parameters	Value
Particle size distribution %	
Coarse Sand	50.4
Fine Sand	40.4
Silt	3.20
Clay	6.00
Texture class	Sandy
Chemical properties	
$CaCO_3$ %	1.40
pH(Suspension 1: 2.5)	7.92
EC dS/m (saturated past extract)	0.37
Organic matter %	0.40
Soluble cations and anions (meq L^{-1})	
Ca^{++}	0.95
Mg^{++}	0.89
Na^{+}	1.51
K^{+}	0.45
CO_3^{--}	-
HCO_3-	1.42
Cl-	1.02
SO_4^{--}	1.36
Available nutrients (mg kg^{-1})	
N	66.0
P	12.0
K	45.6

The applied rates of nitrogen were mixed once with bentonite (5ton /Fed^{-1}), the other with potassium humate (30 L/ Fed^{-1}) and finally, such rates with bentonite + potassium humate (bento +KH) together. The treatments were 100 % N, 100% N + bento, 100% N+ KH and 100% N+ (bento + KH). The same treatments were mixed with either 75% N or 50% N. Mineral fertilizer were applied at recommended dose for wheat crop. Phosphorus was added in the form of (15 % P_2O_5) at a rate of 200 Kg $fed.^{-1}$ basically before sowing; potassium was added in the form of potassium sulfate (48 % K_2O) at 50 Kg fed. $^{-1}$, nitrogen was added in the form ammonium nitrate (33 % N) rates at 360 Kg fed. $^{-1}$. The dose of nitrogen was added at three times 15, 30 and 60 days from sowing. Bentonite was added before cultivation and mixed with soil surface 20 cm. Potassium humate was sprayed on soil surface three times at 20, 40 and 60 days from sowing.

Table 2. Selected chemical properties of potassium humate.

Parameters	Values	Parameters	values
pH	8.10	P mg L^{-1}	9.60
OC %	0.63	Ca mg L^{-1}	400
OM %	1.08	Mg mg L^{-1}	336
C/N	1.21	Fe mg L^{-1}	10.9
N %	0.52	Mn mg L^{-1}	1.70
K %	4.00	Zn mg L^{-1}	0.30
Na %	0.83	Cu mg L^{-1}	0.50

Table 3. Selected chemical properties of the natural bentonite

pH	EC dSm^{-1}	OC %	OM %	CEC C mol kg^{-1}	N mg kg^{-1}	P mg kg^{-1}	K mg kg^{-1}
8.01	3.77	0 .79	1.36	64	350	8.38	783

At maturity, plants were harvested after 120 day to evaluate yield components (grains and straw) and nutrient status. Plant samples were oven dried at 70 ˚C until constant dry weight, then ground and digested using H_2SO_4 and H_2O_2 mixture described in Page *et al*. (1982). Soil chemical parameters including pH, organic matter, CEC and available N, P and K along with analyses for natural minerals were evaluated according the procedures described by Cottenie *et al*. (1982). Obtained results were subjected to statistical analysis according to Snedecor and Cochran (1982), and the treatments were compared by using the least significant difference (L.S.D) at 0.05 level of probability.

RESULTS AND DISCUSSION

Soil characteristics.

Data in Tables (4 and 5) show the effect of potassium humate and bentonite along with bentonite + potassium humate as a combination on soil parameters of pH, OM, CEC, and available nutrients (N, P and K) under impact of nitrogen rates at the two seasons.

1- Soil pH.

Results revealed no significant response of mean pH values to nitrogen rates of 100, 75 or 50% of N compared to control treatments. Generally, the same results were observed among other treatments at the two studied seasons. This may be due to that potassium humate works as a buffer which help to stabilize soil against strong pH changes created from fertilizer application. This agrees with resultant of Campitelli *et. al.,* (2008)

2- Organic matter.

Results indicated that significant positive responses were observed with OM mean values obtained with nitrogen rates of either 100 or 75 along with 50 % compared to control treatments under impact of either potassium humate (HK) or bentonite (Bento). On the other hand, there were no significant responses among all rate of nitrogen. The superior treatment was, however, observed at treatment in a combination with (HK+ Bento) of each rates of nitrogen because potassium humate works as organic matter which promote of microorganisms in soil. (Khaled and Fawy 2011). Of course, high-clay of bentonite, should improve the physical and chemical properties of sandy soils. This simulates resultant of Yssaad and Belkhodja (2007) who found that addition of bentonite to sandy soil allow improving of physical and chemical properties.

3- Cation exchange capacity (CEC)

Results revealed that significant positive responses for CEC with effectiveness all treatments compared to control treatments. Also, there were significant responses of nitrogen rates fertilizer 100 or 75 as well as 50 % of N. The superior treatment was obtained at bentonite + potassium humate which being shown the effect favorable of organic and mineral soil conditioner on chemical and physical soil properties. Due to the HK which is rich in carboxylic, phenolic groups, and aromatic nature provide favorable soil conditioners. Also, it has been biological activity; chemical reactions and physical improvement of soil its promoting chemical reaction for cation exchange capacity. (Dejou 1987 and Amjad *et al.* 2010). Also, Croker *et al.* (2004) decided that bentonite was considered a 2:1 clay mineral which increases in the CEC simply as a consequence of yhier high net permanent negative charged in soil. Therefore, it can also improve the retention and availability preferable to add bentonite to sandy soil.

4 - Available nutrients in soil.

Results, generally, showed positive responses of N, P and K available with compared to control treatments. For indicated that the effect of bentonite, potassium humate as well as bentonite + potassium humat as a combination. On the other hand, there are no significant responses under effect of nitrogen rates either 100 or 75 along with 50 % N. Corresponding the superior treatments of nutrients available were the (HK+ Bento) which being the best effect. This may be related with the increases of CEC when added the soil conditioner (HK+ Bento) to the soil the along with improving the chemical properties of sandy soil (Reguieg *et al*., 2011). Also,Czaban *et al*., (2013) found that the minerals of 2:1 types can adsorb greater amounts of element and organic materials than 1:1 type due to large specific and high- charge densities in 2:1 type clays. In regard to the potassium humate products are usually available in the form of soluble salts. Furthermore, Croker *et al*., (2004) applied that bentonite can improve the retention and availability of nutrients, enhancing agricultural productivity and improving fertiliser use efficiency (Fonge *et al*., 2007). This is true because the K- humate enhancing the availability of essential plant nutrients N, p and K. Whereas, its containing basically humic acid when added as individual treatment or combined with other soil conditioners surpassed the other treatments (Abdel-Razek *et al*., 2011)

Plant growth

1- Total yield, grains and straw of wheat crop

The treatments had significant effect on mean values of total yield, grains and straw in both seasons were shown in Table 6 and Fig1 compared to control treatments. Concerning nitrogen rates, results indicated that no significant increases between them 100, 75 or 50 % of nitrogen. This is favorable for soil because soil amendments were playing a good role in improvement of soil properties either chemical or physical which increase soil fertility. This is reflected on yield of wheat crop when applied the 75 or 50 % of N which had to the decrease consumption of nitrogen fertilizer. This may able to indirect and direct effecting on the physical system of grown plant under impact of potassium humate treatments. Its provide minerals encourage the micro- organism population; provide biochemical substances which reflected on crop growth (Young *et al*., 2006). Moreover, the addition of bentonite and HK as a combination was playing an important role in sandy soil whereas the bentonite improved the physical soil properties epically soil aggregates and water holding capacity. (Croker *et al*., 2004)

Table 4. Effect of soil applied conditioners on pH, OM, CEC and available elements under the studied rates of nitrogen fertilizer (first season).

Treatments				Cmol kg^{-1}	Mg kg $^{-1}$		
N rates	Soil conditioners.	Ph (1:2suspension)	%OM	CEC	N	P	K
100	Cont	8.01 $_{A.E}$	0.12 $_{CD}$	12.3$_{CD}$	158 $_{B}$	75 $_{AB}$	65$_{B}$
	Bent	7.98 $_{B.E}$	0.29 $_{BC}$	35.7$_{A.C}$	163$_{AB}$	78 $_{AB}$	66 $_{B}$
	HK	8.09 $_{C.E}$	0.33 $_{A.C}$	36.7$_{AB}$	172$_{AB}$	81 $_{AB}$	67 $_{B}$
	Bentont+HK	8.10 $_{A.E}$	0.39 $_{A.C}$	49.3 $_{A}$	177$_{AB}$	99 $_{AB}$	79 $_{B}$
Mean		8.04 $_{A}$	0.29 $_{A}$	36.0 $_{A}$	168 $_{A}$	83 $_{A}$	69 $_{B}$
75	Cont	8.07 $_{A.C}$	0.55 $_{D}$	19.0 $_{D}$	168$_{AB}$	70 $_{AB}$	75 $_{B}$
	Bent	7.87 $_{E}$	0.81 $_{AB}$	28.3$_{B.D}$	172$_{AB}$	90 $_{AB}$	139 $_{A}$
	HK	8.09 $_{A B}$	0.81 $_{A}$	25.3$_{B.D}$	186$_{A}$	91$_{AB}$	157 $_{A}$
	Bentont+HK	8.07 $_{A E}$	0.94 $_{AB}$	36.7$_{AB}$	186$_{A}$	109 $_{A}$	147 $_{A}$
Mean		8.02 $_{A}$	0.53 $_{A}$	27.3 $_{B}$	178$_{A}$	90 $_{A}$	129 $_{A}$
50	Cont	8.02 $_{A E}$	0.46$_{A.C}$	15.0 $_{D}$	163$_{AB}$	61 $_{B}$	143 $_{A}$
	Bent	8.16 $_{A}$	0.78 $_{AB}$	19.7 $_{D}$	172$_{AB}$	79 $_{AB}$	154 $_{A}$
	HK	8.09 $_{AB}$	0.53 $_{A.C}$	16.0 $_{D}$	172$_{AB}$	76 $_{AB}$	152 $_{A}$
	Bentont+HK	8.14 $_{AB}$	0.60 $_{A.C}$	34.3 $_{BC}$	182$_{AB}$	88 $_{AB}$	169 $_{A}$
Mean		8.01 $_{A}$	0.59 $_{A}$	21.2 $_{C}$	172$_{A}$	76 $_{A}$	154 $_{A}$

Table 5. Effect of soil applied conditioners on pH, OM, CEC and available elements under the studied rates of nitrogen fertilizer (second season).

Treatments				Cmol kg $^{-1}$	Mg kg $^{-1}$		
N rates	Soil conditioners	pH (1:2 suspension)	%OM	CEC	N	P	K
	Cont	8.26_{A}	0.37_{C}	15_{F}	191_{B}	27_{C}	31_{B}
100	Bent	7.95_{BC}	0.78_{BC}	22_{E}	207_{AB}	38_{C}	46_{AB}
	HK	7.94_{BC}	0.64_{BC}	26_{B}	191_{B}	56_{B}	31_{B}
	Bentont+HK	8.08_{AC}	0.80_{BC}	30_{A}	210_{AB}	56_{B}	48_{AB}
Mean		8.06_{A}	0.65_{B}	23_{A}	200_{A}	44_{B}	39_{AB}
	Cont	8.07_{AC}	0.34_{C}	17_{F}	191_{B}	56_{B}	31_{B}
75	Bent	8.05_{AC}	0.78_{BC}	15_{F}	201_{B}	72_{A}	40_{AB}
	HK	8.16_{AB}	0.71_{BC}	26_{D}	210_{AB}	71_{AB}	36_{AB}
	Bentont+HK	8.00_{AC}	0.67_{A}	32_{B}	219_{AB}	74_{A}	40_{AB}
Mean		8.07_{A}	0.88_{A}	23_{B}	205_{A}	68_{A}	37_{B}
	Cont	7.95_{AC}	1.78_{BC}	15_{F}	191_{B}	56_{B}	31_{B}
50	Bent	8.26_{A}	1.78_{BC}	15_{F}	201_{B}	68_{AB}	49_{AB}
	HK	8.16_{AB}	1.71_{BC}	15_{F}	196_{B}	62_{AB}	40_{AB}
	Bentont+HK	8.15_{AB}	2.26_{AC}	32_{C}	233_{A}	66_{AB}	51_{A}
Mean		8.12_{A}	1.88_{A}	20_{C}	205_{A}	63_{A}	43_{A}

Table 6. Effect of soil conditioners on grains and straw yields of wheat crop under the studied rates of nitrogen fertilizer (first and second seasons).

Treatments		First season kg Fed^{-1}		Second season kg Fed^{-1}	
N rates	Soil conditioners.	Grains	straw	Grains	straw
	Cont	1676_{C}	1943_{B}	1562_{BC}	2491_{E}
100	Bent	1955_{BC}	2729_{B}	2540_{A}	2528_{E}
	HK	1938_{BC}	2227_{B}	2614_{A}	3909_{AD}
	Bentont+HK	2671_{A}	3362_{A}	2820_{A}	4144_{AD}
Mean		2060_{A}	2565A	2384_{A}	3268_{A}
	Cont	1638_{C}	1293_{B}	1268_{C}	3226_{CE}
75	Bent	2106_{AC}	2420_{B}	2624_{A}	3341_{BE}
	HK	2318_{AB}	3214_{B}	2660A	3712_{AE}
	Bentont+HK	2642_{A}	3783_{B}	2920A	5024_{A}
Mean		2176_{A}	2678_{A}	2368A	3970_{A}
	Cont	1648_{C}	1956_{B}	1236_{C}	3011_{DE}
50	Bent	1820_{BC}	2786_{B}	1596_{BC}	4563_{AC}
	HK	2054_{AC}	2511_{B}	1884_{B}	3693_{AE}
	Bentont+HK	2250_{AC}	2804_{B}	2436_{A}	4611_{AB}
Mean		1943_{A}	2514_{A}	1788_{B}	3970_{A}

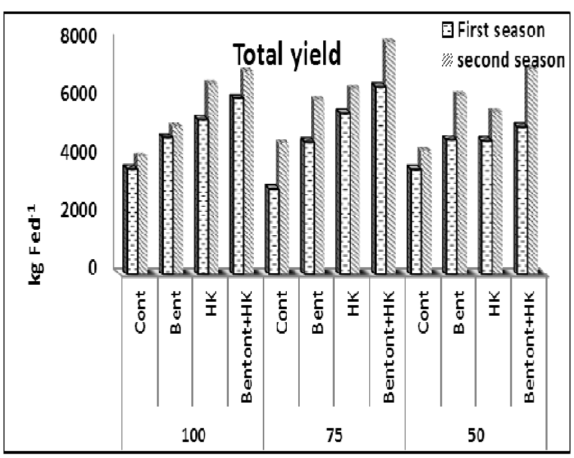

Fig. 1. Effect of soil conditioners on total yield of wheat crop under the studied rates of nitrogen fertilizer (first and second seasons).

2- N, P and K status in wheat plant

The total content of N, P and K in both straw and grain of grown wheat crop as affected by betntonite and potassium humate under different applied rates of nitrogen fertilizer in both studied seasons are shown in Tables (7 - 8). Data noticed that total content of nitrogen, phosphorus and potassium was significant increase of mean values to applied treatments compared to control treatments; the superior treatments were observed in combination of (bento + HK) conditioner. On the other hand, there is no significant increase between treatments of nitrogen rates. These favorable effects may be related to the status of soil fertility with relatively ample which nutrients availability for plant (Wanas, 1996). Also, Mackowiak *et al*., (2001) and Madlain and Salib (2002) reported that, the great function of K- humate which improve the efficiency of nutrients uptake particularly when using sprinkling technique.

Table 7. Effect of soil conditioners on total content of nutritional element under the studied rates of nitrogen fertilizer (first season).

Treatments		N kg fed^{-1}		P kg fed^{-1}		K kg fed^{-1}	
N rates	**Soil conditioners**	**Straw**	**Grains**	**straw**	**Grains**	**straw**	**Grains**
	Cont	44.1_{B}	45.1_{D}	9.41_{B}	14.4_{B}	16.1_{B}	4.14_{E}
100	Bent	40.1_{B}	49.7_{D}	8.60_{B}	16.7_{B}	17.7_{B}	5.10_{CE}
	HK	49.9_{B}	51.9_{D}	9.56_{B}	16.3_{B}	16.1_{B}	6.44_{AC}
	Bentont+HK	57.8_{A}	73.4_{A}	72.2_{A}	23.3_{B}	31.6_{A}	7.75_{A}
Mean		48.0_{A}	55.0_{A}	24.9_{A}	17.7_{B}	20.4_{A}	5.86_{A}
	Cont	19.9_{B}	45.3_{D}	3.93_{B}	16.6_{B}	7.70_{B}	4.48_{DE}
75	Bent	46.3_{B}	65.3_{A}	7.50_{B}	19.6_{B}	15.9_{B}	5.49_{CE}
	HK	48.3_{B}	64.9_{B}	9.92_{B}	23.0_{B}	20.6_{B}	5.94_{BD}
	Bentont+HK	66.3_{B}	80.6_{A}	14.0_{B}	35.0_{A}	25.4_{B}	7.57_{AB}
Mean		45.2_{A}	64.0_{A}	8.84_{A}	23.5_{A}	17.4_{A}	5.87_{A}
	Cont	27.8_{B}	44.4_{D}	3.61_{B}	13.5_{B}	11.3_{B}	4.41_{CE}
50	Bent	41.6_{B}	51.0_{D}	9.69_{B}	15.8_{B}	18.9_{B}	5.09_{CE}
	HK	35.8_{B}	52.5_{D}	9.52_{B}	17.1_{B}	14.8_{B}	5.31_{CE}
	Bentont+HK	43.9_{B}	63.9_{C}	8.86_{B}	21.8_{B}	17.0_{B}	5.92_{CD}
Mean		37.3_{A}	52.9_{A}	7.92_{A}	17.1_{B}	15.5_{A}	5.18_{A}

Table 8. Effect of soil conditioners on total content of nutritional element under the studied rates of nitrogen fertilizer (second season).

Treatments		N kg fed^{-1}		P kg fed^{-1}		K kg fed^{-1}	
N rates	**Soil conditioners.**	**Straw**	**Grains**	**Straw**	**Grains**	**straw**	**Grains**
	Cont	20.9_{E}	30.7_{DF}	6.76_{D}	10.3_{DE}	11.0_{E}	4.15_{EF}
100	Bent	23.3_{CE}	55.8_{AB}	$8.27C_{D}$	16.8_{BC}	13.6_{CE}	7.15_{BD}
	HK	38.4_{AE}	65.4_{A}	18.36_{BC}	17.4_{BC}	20.8_{BC}	7.10_{CD}
	Bentont+HK	52.3_{AC}	63.6_{A}	$22.7A_{B}$	21.5_{AB}	23.9_{B}	9.25_{AB}
Mean		33.7_{A}	53.9_{A}	14.03_{A}	16.5_{AB}	17.3_{A}	6.91_{A}
	Cont	22.7_{CE}	23.9_{EF}	9.3_{CD}	6.10_{E}	14.8_{CE}	3.45_{F}
75	Bent	30.0_{CE}	53.0_{AB}	11.5_{BD}	17.2_{BC}	19.5_{BD}	7.62_{AD}
	HK	36.9_{AE}	52.4_{AB}	15.5_{BD}	22.6_{AB}	19.2_{BD}	8.08_{AC}
	Bentont+HK	63.2_{A}	62.5_{A}	30.3_{A}	26.3_{A}	37.7_{A}	9.55_{A}
Mean		38.2_{A}	48.0_{AB}	16.7_{A}	18.1_{A}	22.8_{A}	7.17A
	Cont	21.5_{DE}	20.2_{F}	11.6_{BD}	7.30_{E}	12.7_{DE}	3.04_{F}
50	Bent	50.9_{AD}	36.5_{CE}	13.4_{BD}	7.30_{E}	22.5_{B}	4.67_{EF}
	HK	33.2_{BE}	42.7_{BD}	14.4_{BD}	14.4_{CD}	18.5_{BE}	5.72_{DE}
	Bentont+HK	60.4_{AB}	52.0_{AC}	21.5_{AB}	17.2_{BC}	34.6_{A}	7.27_{BD}
Mean		41.5_{A}	37.9_{B}	15.2_{A}	11.5_{B}	22.1_{A}	5.1_{8B}

CONCLUSION

The results of this study indicate that soil conditioners (combination of bentonite and potassium humate) were favorable to soil parameters including pH, organic matters, cation exchange capacity and nutrient availability. In other words, it rise the fertility of sandy. The same trend was observed for plant growth and nutritional elements content. Also, results suggested that, the possibility of using either 75 or 50 % N rate instead of 100% N; therefor saving the consumption of nitrogen fertilizer

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تأثير هيومات البوتاسيوم والبنتونيت علي بعض الخواص الكيميائية للتربة الرملية تحت معدلات مختلفة من التسميد النيتروجيني

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أجريت تجربة حقلية خلال موسمي شتوي ٢٠١٥ و ٢٠١٦ على محصول القمح المنزرع فى تربة رملية تحت نظام الري بالرش بمحطة بحوث الأسماعيلية – مركز البحوث الزراعية ، لدراسة تأثير محسنات التربة (البنتونيت وهيومات البوتاسيوم) علي بعض الخواص الكيميائية للتربة الرملية المضاف إليها معدلات التسميد النيتروجيني (١٠٠و ٧٥ و٥٠ %) بالأضافة إلي انتاجية وامتصاص العناصر المغذية لنبات القمح. أشارت النتائج بعدم وجود تأثير معنوي لدرجة حموضة التربة تحت تأثير المعاملات المضافة مقارنة بمعاملة الكنترول. كان ذلك عكسيا مع كل من المادة العضوية والسعة التبادلية الكاتيونية حيث دلت النتائج علي زيادة كل منهم تحت تأثير البنتونيت وهيومات البوتاسيوم بالرغم من عدم وجود زيادة معنوية بينهم تحت تأثير معدلات النيتروجين. تشيرالنتائج عموما, إلي وجود تأثير إيجابي للمعاملات علي تيسر النيتروجين , الفوسفور والبوتاسيوم في التربة مقارنة بالكنترول . كذلك اشارت النتائج إلي وجود تأثير معنوي ايجابي علي المحصول الكلي (القش والحبوب) بالاضافة الي المحتوي الكلي للنيتروجين ، الفوسفور والبوتاسيوم في النبات. من خلال هذة الدراسة يمكن أستنتاج أن أفضل معاملة كانت مخلوط البنتونيت وهيومات البوتاسيوم معا وذلك لتحسين خواص التربة الكيميائية التي تنعكس علي تحسين خصوبة التربة. كذلك أدي أستخدام المحسنات إلي توفير السماد النيتروجيني بحيث يمكن اقتراح استخدام معدلات ال ٧٥ و ٥٠ % بدلا من ١٠٠% من السماد النيتروجيني وذلك لعدم وجود اختلافات معنوية بينهم.