Zagazig Journal of Soil and Water Science 1587-1599

Zagazig J. Agric. Res., Vol. 43 No. (5) 2016

http:/www.journals.zu.edu.eg/journalDisplay.aspx?Journalld=1&queryType=Master

WHEAT PRODUCTIVITY ON A SANDY SOIL TREATED WITH COMBINATIONS OF VINASSE AND ORGANIC ACIDS*

Wafaa M.T. Eletr and Hanaa A. Zein El-Abdeen*

Soil, Water and Environ. Res. Inst., Agric. Res. Cent. (ARC), Giza, Egypt

ABSTRACT

A field experiment was carried out for two successive winter seasons at Ismailia Agric. Res. Station in Ismailia Governorate, Egypt to evaluate possibility of using vinasse in combination with some organic acids for improving nutrients status of the sandy soil and its reflection on wheat (Giza 168) yield productivity. The experiment was laid out in split plot design, with three replicates. the main plots included five treatments including control (recommended NPK. dose), vinasse (V), vinasse and humic acid (VH), vinasse and fulvic acid (VF), vinasse and humic substances (VHS). The sub-main plots represented treatments with different rates of 0, 20, 30 and 40 liters faddan^{-1}. All treatments were sprayed on the sandy soil three times at 30, 45 and 60 days from shown during two cultivated seasons. Results revealed that wheat yield (straw and grains) along with total content of N, P and K generally increased significantly in response to vinasse and fulvic acid (VF) treatment as compared to either control or other treatments. Moreover, values of wheat plant increased by increasing vinasse application in combination with different forms of organic acid as compared to either applied vinasse alone or control treatments; the superior rate was 40 L faddan^{-1}. On the other hand, the application of some organic conditioners slightly decreased both pH and EC values as compared to control treatment. Relatively different trend was observed with organic matter and saturation percent which increased in all treatments as compared to control treatment. Also, available NPK in soil were also increased gradually by increasing rate of organic conditioners. In conclusion, application of vinasse combined with other organic acids (humic, fulvic and humic substances) generally enhanced wheat yield productivity, total content of macronutrients in both straw and grains along with improved some chemical properties of sandy soil under investigation.

Key words: Soil conditioners, vinasse, humic acids, fulvic acid, humic substances, soil chemical properties, wheat (*Triticum aestivum* L.).

INTRODUCTION

Vinasse is a waste material by product from distillery suger cane industries which has potential to cause major environmental problems across the world (Sajbrt *et al.,* 2010 ; Muhammed *et al.,* 2012).Vinasse has high levels of potassium, calcium and organic matter in its chemical composition as well as moderate amounts of nitrogen and phosphorus (Gloria, 1985). Vinasse improves most factors involved in soil fertility, provides favoring conditions for nitrogen assimilation into the soil, protects nutrients against washing out in winter and maintains them as reserve nutrients as a slow release during the vegetative period. These are the most important affect, leading to increase yield and quality of crops (Haggag *et al.,* 2013; Shahin *et al.,* 2015; Haggag *et al.,* 2015).

Humic acids are one of the major components of humic substances. Humic matter is formed through the chemical and biological humification of plant and animal wastes and through the biological activities of microorganisms (Anonymous, 2010). Also, humic acids improves the physical, chemical and biological properties of the soil, maximum efficiency of nutrient

* The material of this research article was presented in the conference on “Security of the Egyptian Soils”, held in the Faculty of Agriculture, El-Zagazig , 10-11 April 2016

***Corresponding author: Tel. :** +201224293267
E-mail address: hannaazeinelabdeen@yahoo.com

utilization and influences plant growth (Van Schoor *et al.,* 2012). In many studies, humic acids and its derivatives were applied to enhance the uptake of nutrients (Mackowiak *et al.,* 2001) and promote the root length (Cenellas *et al.,* 2002) and to increase the fresh and dry weight of crops (Chen *et al.,* 2004a,b). Haggag *et al.* (2015) detected that application of humic acid treatments in the form of Actosol (20% humic +NPK 1:5:6) with three doses (150, 75 and 50 cm^3) were increased olive yield by (55.67, 45.67 and 40.35 kg/tree) and (55.05, 44.67 and 36.67 kg/tree) in the first and second seasons, respectively. Also, Brunetti *et al.* (2007) found that 2% humic acids increased the grain and straw yields of wheat by 26% and 23.8%.

Fulvic acid is a derivative of humic acids, but it has a smaller molecular size (Grenthe and Puigdomenech, 1997) and is less stable in soil due to its greater exposure to microbial degradation. It occurs naturally in soil, water and peat like humic acids, and it modifies the soil structure by binding to sand, silt and clay due to its colloidal characteristics (Mayhew, 2004). Due to high ion exchange and hydrolysis capacity of fulvic acid, the resulting excess amounts of amino acids and organic acids increase the soil cation exchange capacity. Fulvic acid decreases soil loss, increases soil fertility and facilitates the transfer of mineral nutrients from the soil to plants. fulvic acid can function as a plant hormone (Akinci and Ongel, 2011)

Humic substances have been reported to influence plant growth both directly and indirectly. The effects of humic compounds on soil fertility include: (i) Increase in the soil microbial population including beneficial microorganisms. (ii) Improved soil structure. (iii) Increase in the cation exchange capacity and the pH buffering capacity of the soil (Saruhan *et al.,* 2011).

When adequate humic substances are present within the soil, the requirements for nitrogen, phosphorus and potassium fertilizer applications may be reduced (Pettit, 2004). Humic substances are major components of organic matter, often representing 60 to 70% of the total organic matter (Schnitzer and Khan, 1972).

The main target of this work is to maximize the use of some industrial wastes by mixing with some organic acids and its impact on the chemical properties of sandy soil and wheat crop productivity.

MATERIALS AND METHODS

A field experiment was carried out for two successive winter seasons at Ismailia Agric. Res. Station, Ismailia Governorate, Egypt (Latitude, 30° 35' 41.901" N and longitude, 32° 16' 45.834" E), to evaluate possibility of vinasse usage in combination with some organic materials for improving nutrient status of the sandy soil and its reflection on wheat (Giza 168 cultivar) yield productivity. Some physical and chemical characteristics of the studied soil are presented in Table 1.

The experiment was laid out in split plot design, with three replicates, the main plots included five treatments, control (recommended dose NPK.), vinasse (V), vinasse and humic acids (VH), vinasse and fulvic acid (VF), vinasse and humic substances (VHS). The sub-main plots represented treatments for different rates of 0, 20, 30 and 40 l fad^{-1}. All treatments sprayed on the sandy soil three times at 30, 45 and 60 days from sowing during two cultivated seasons. Some chemical characters of organic materials used in this experiment are presented in Table 2.

All treatments received mineral fertilizers at the recommended dose from superphosphate (15% P_2O_5) at a rate of 200 Kg $fad.^{-1}$ basically before sowing; potassium was added in the form potassium sulfate (48% K_2O) at 50 Kg $fad.^{-1}$ for wheat plant. Nitrogen was added in the form ammonium nitrate (33.5% N) at rates of 358 Kg $fad.^{-1}$ for wheat plant. Ammonium nitrate was added four split equal doses after 2, 4, 6 and 8 weeks from sowing. While potassium was divided into two equal doses, the first was added at sowing and the second after 35 days from sowing of both seasons, respectively.

At harvest, surface soil samples were subjected to analyses of some soil chemical properties according to Cottenie *et al.* (1982), the studied parameters are:

Table 1. Some characteristics of soil samples representing the studied site

Soil characteristic	Value	Soil characteristic	Value
Particle size distribution (%)		**Soluble cations and anions (meq L^{-1})**	
Coarse sand	57.0	Ca^{++}	0.81
Fine sand	33.2	Mg^{++}	0.73
Silt	3.92	Na^{+}	1.50
Clay	5.88	K^{+}	0.42
Texture class	Sandy	CO_3^{--}	-
		HCO_3^{-}	1.50
		CL^{-}	2.10
		SO_4^{--}	0.14
Chemical properties		**Available nutrients (mg L^{-1})**	
$CaCO_3$ * (%)	1.82		
pH (suspension 1:2.5)	7.80	N	83.0
EC dSm^{-1} (Saturated paste extract)	0.39	P	19.0
Organic matter (%)	0.60	K	65.6

Table 2. Some chemical characters of organic materials used

Parameter	Vinasse	Humic acid	Fulvic acid	Humic substances
pH	4.50	6.0	2.0	12.6
EC dS m^{-1}	21.1	59.0	55.3	61.4
OM (%)	25.9	13.0	12.9	13.1
N	1.42 %	710 mg L^{-1}	705 mg L^{-1}	650 mg L^{-1}
P_2O_5	0.30 %	200 mg L^{-1}	150 mg L^{-1}	190 mg L^{-1}
K_2O	4.22 %	4.0 %	3.90%	4.10%

a- Soil pH was determined in 1:2.5 soil water suspensions.

b- Electrical conductivity (dSm^{-1}) of the soil paste extract.

c- Organic matter content (%).

d- Available N, P and K (mg Kg^{-1})

e- Cations and Anions (meq L^{-1})

Samples of both straw and grains for crop was collected from each plots, weighed and oven dried at 70°C for 48 hr., up to a constant dry weight, ground and prepared for digestion using as described by Page *et al.* (1982). The digests were then subjected to the evaluation of nutrients (N, P and K) according to procedures described by Cottenie *et al.* (1982).

Apparent nutrients recovery (ANR) by calculated according to Quanbao *et al.* (2007).

$$ANR = \frac{A - B}{C} \times 100$$

A : Uptake in fertilized plot (Kg $fad.^{-1}$)

B :Uptake in control plot (Kg $fad.^{-1}$)

C: Quantity of fertilizer nutrient applied (Kg $fad.^{-1}$).

Harvest index was calculated by using the following formula (Fageria and Baligar, 1997):

Harvest index (%) =

$$\frac{\text{Grain yield (Kg fad.}^{-1}\text{)}}{\text{Biological yield (Kg fad.}^{1-}\text{)}} \times 100$$

Obtained results were subjected to statistical analysis according to Snedecor and Cochran (1980) and the treatments were compared by using LSD at 0.05 level of probability.

RESULTS AND DISCUSSION

Wheat Yield

Statistical analysis of data in Table 3 show that the mean values of grain and straw yield of wheat plant had increased significantly by vinasse applied in combination with fulvic acid compared to other treatments, such increase reach to 47.1%, 23.3% for grain yield and 78.1%, 45.9% for straw yield in two successive seasons as compared to control treatment, respectively. These increases may be due to fulvic acid and its role as a plant hormone (Akinci and Ongel, 2011). Also, the increase of wheat yield as a result of vinasse and organic acids application may be attributed to better growth under favorable physical condition of treated soil can be related to beneficial effect of vinasse and humate materials containing a considerable amount of organic matter of nutritional elements for plant growth. (Arafat and Yassen, 2002).

Regarding to organic material concentrations, the mean vales in Table 3 showed that by increasing the rate of application generally increased both grain and straw yields; the highest value was observed with 40 L fad.

In general, obtained results showed that wheat crop yields (grain and straw) were increased significantly in all treatments as compared to control. The treatments of different soil conditioners can be arranged as the following order VF> V> VHS> VH. Such results are in harmony with Seyedbagheri (2010) who stated that potato yields increased with increasing rates of humic materials application up to 30 L/humic acid/acre as organic conditioner, but were reduced at the highest treatment of 60 L/humic acids/acre. The impacts on yield could be due to the effects of humic acids on the reactions that form organic-clay complexes “This reaction contributes to the creation of stable humus, which impacts soil physical, chemical and biological functions. Radwan *et al.* (2015) indicated that the highest humic materials application rate (4kg/fad.) produced the highest grain yield (2.77 and 2.80 ton/fad.), biological yield (6.42 ton /fad.) in both seasons.

On the other hand, harvest index of wheat crop yield was slightly increased and such increase was not significant between concentrations rates applied in all treatments. Similar results were obtained with Radwan *et al.* (2015) who added that the differences between 3 and 4 kg humic fad^{-1} did not reach the significance level for harvest index in the two seasons.

Total Content of N, P and K in Wheat Plant

Data in Table 4 show that the most humate materials and vinasse had a positive effect on macronutrients total content in comparison with control, however VF treatments recorded high levels of NPK uptake comparing with the other treatments. With respect to organic conditioner rates, NPK total content by wheat plant was significantly increased by increasing the application rate (40 L fad.$^{-1}$) of all treatments in two successive seasons.

Sharaf El-Din *et al.* (2011) stated that the increase in the N, P, K (%), could be resulted from the increase in the uptake of the nutrients through the root system, which became more capable of absorbing more amounts of nutrients due to hormone-like activity of fulvic acid from the vermi composts or due to plant growth hormones adsorbed. This is related to the surface activity of humic substances resulting from the presence of both hydrophilic and hydrophobic sites (Chen and Schnitzer, 1978). Humic can affect the solubility of insoluble phosphorus compounds in soil by its chelation capacity, and chelated metals are also available to plants by exchange (Tan, 2003). Also, the humic substances may interact with the phospholipid structures of the cell membranes and react as carriers of nutrients through them. In addition, Arafat and Yassen (2002) found that by increasing rate of vinasse from 1% to 2% the N, P and K uptake increased and this was parallel to the grain and straw yields increase.

Table 3. Effect of different rates of vinasse in combination with organic acids on wheat yield productivity at two successive winter seasons

Organic conditioner	Rate of application (L fad.$^{-1}$)	First season			Second season		
		Grain	Straw	Harvest index (%)	Grain	Straw	Harvest index (%)
		Kg fad.$^{-1}$			Kg fad.$^{-1}$		
		1201	1528	44	1413	1574	47
V	20	1382	1808	43	1434	1837	44
	30	1578	2203	42	1866	2250	45
	40	2008	2881	41	2348	2907	45
	Mean	1656	2297	42	1883	2332	45
VH	20	1296	2476	34	1476	2461	37
	30	1341	2703	33	1567	2735	36
	40	1617	3054	35	1931	3093	38
	Mean	1418	2744	34	1658	2763	38
VF	20	1452	2852	34	1713	2915	37
	30	1816	2626	41	2151	2672	45
	40	2033	3137	39	2336	3177	42
	Mean	1767	2872	38	2067	2922	41
VHS	20	1264	2577	33	1480	2645	36
	30	1576	2834	36	1763	2852	38
	40	1844	3036	38	2152	3116	41
	Mean	1561	2816	36	1798	2871	38
Mean of organic conditioners (A)	V	1656	2297	42	1790	2331	43
	VH	1417	2744	34	1785	2871	39
	VF	1766	2871	37	2066	2921	41.2
	VHS	1561	2815	35	1798	2871	38.6
	Cont.	1201	2328	34	1160	2001	37.4
Mean of application rates (B)	20	1319	2448	37	1452	2372	38.5
	30	1502	2518	37	1646	2502	39.6
	40	1740	2867	35	2061	2859	41.9
LSD at 0.05%							
A (conditioner)		417.3	546.7	9.06	322.8	593.9	7.1
B (rates)		307.6	410.0	4.07	315.2	315.5	4.0
A × B		251.4	334.8	3.3	257.0	320.2	3.3

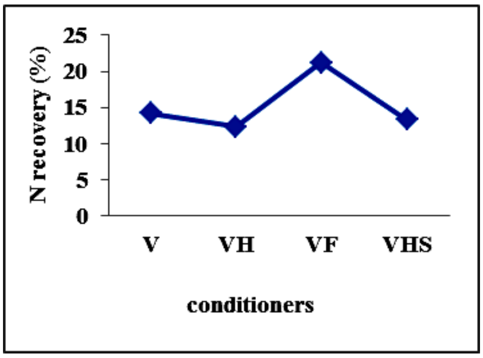
V= venasse, H= Humic acids, F= Fulvic acid, HS= Humic substances

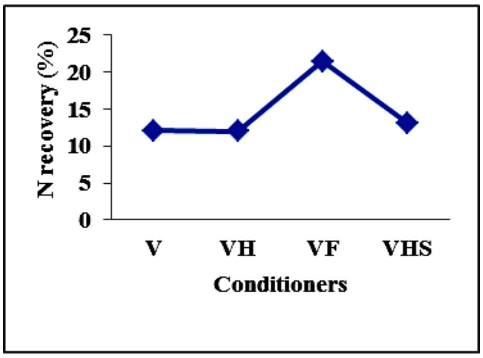
Table 4. Effect of different rates of vinasse in combination with different organic acids on macronutrients total content by wheat crop at two successive seasons

Organic conditioner	Rate of application (L fad.$^{-1}$)	Macronutrients total content (kg fad.$^{-1}$)											
		First season						Second season					
		Straw			Grain			Straw			Grain		
		N	P	K	N	P	K	N	P	K	N	P	K
		31.2	8.1	15.3	30.0	5.4	13.8	32.3	8.3	11.5	31.8	5.7	15.9
V	20	36.3	8.1	18.1	33.2	6.4	16.3	37.2	12.5	16.8	31.0	6.0	16.7
	30	38.2	10.1	22.0	33.1	6.9	18.2	39.4	10.4	13.1	35.3	7.4	21.2
	40	47.1	13.7	28.8	46.9	8.8	23.2	48.0	14.0	10.8	49.3	9.3	26.7
	Mean	38.9	10.6	22.9	37.7	7.41	19.2	40.0	10.8	16.4	38.6	7.6	21.6
VH	20	39.6	12.2	24.8	30.7	6.1	14.6	39.8	8.7	12.7	31.4	6.2	16.5
	30	39.2	10.4	27.0	31.7	6.6	15.4	40.0	13.3	13.6	33.4	6.9	17.7
	40	51.9	11.6	30.5	35.0	8.3	19.0	53.1	16.1	14.3	37.7	8.9	22.3
	Mean	43.6	11.4	27.4	32.5	6.99	16.3	44.2	12.5	13.5	34.3	7.3	18.8
VF	20	41.8	8.7	28.5	33.4	6.2	17.4	43.2	9.1	15.5	35.5	6.5	20.2
	30	43.8	13.0	26.3	38.1	7.6	20.9	45.0	11.7	16.1	40.7	7.7	24.4
	40	53.3	15.8	31.4	49.5	8.7	23.4	54.6	11.9	17.9	51.2	9.1	26.5
	Mean	46.3	12.5	28.7	40.33	7.49	20.6	47.5	10.9	16.5	42.4	7.8	23.8
VHS	20	39.5	8.8	25.8	29.5	6.3	14.2	41.0	12.6	14.4	31.1	6.7	16.4
	30	40.6	11.5	28.3	37.3	6.8	18.5	41.3	10.7	16.7	37.5	7.2	20.4
	40	43.5	11.4	30.4	41.2	8.1	20.9	45.1	11.9	17.4	43.2	8.3	24.1
	Mean	41.2	10.6	28.2	35.9	7.04	17.9	42.5	11.7	16.2	37.4	7.5	20.3
Mean of organic conditioners (A)	V	38.7	10.6	29.3	37.7	7.39	19.1	29.5	8.41	23.0	48.2	9.39	26.7
	VH	43.5	12.4	30.9	32.3	6.98	16.4	28.0	8.31	20.1	57.1	12.3	31.4
	VF	46.3	11.4	34.7	40.0	7.1	20.6	32.6	8.22	25.1	60.5	10.6	33.6
	VHS	41.3	10.6	34.4	36.2	7.43	17.9	25.7	6.84	22.0	60.0	12.6	32.4
	Cont.	33.4	10.5	29.1	30.0	5.43	13.7	16.2	5.62	14.5	45.0	8.15	22.7
Mean of rates (B)	20	37.7	9.93	29.3	31.1	6.08	15.2	22.2	5.93	17.5	50.8	9.92	27.0
	30	38.7	11.1	30.1	34.2	6.64	17.3	24.9	7.27	19.7	51.8	10.1	28.5
	40	45.7	12.6	35.7	40.4	7.85	20.1	32.1	9.23	25.7	60.1	11.7	32.5
LSD at 0.5%													
A (conditioner)		7.43	2.3	6.6	11.1	1.45	4.83	5.6	1.49	3.66	15.7	2.88	6.85
B(rates)		7.21	1.7	4.3	7.1	1.4	3.58	4.9	1.51	3.74	9.91	1.75	4.52
A × B		5.6	1.4	4.0	5.8	1.2	2.9	4.0	1.2	3.1	8.1	1.4	3.7

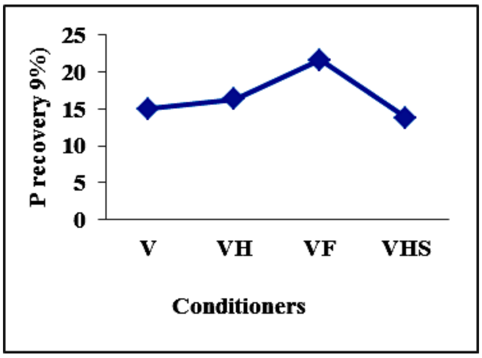
First season | Second season

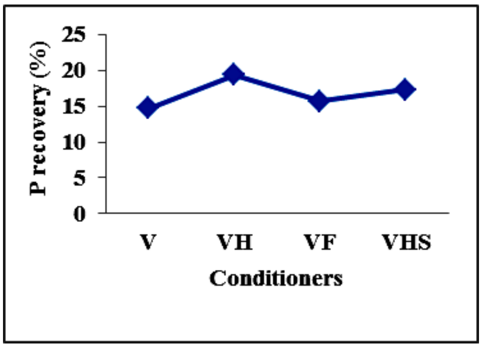
Nitrogen recovery



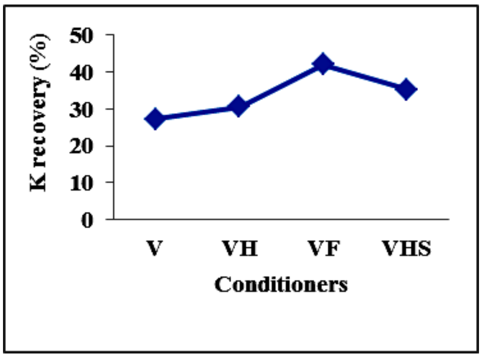


Phosphor recovery





Potassium recovery



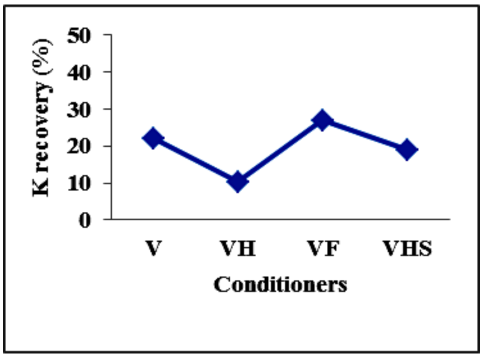


Fig. 1. Nutrients recovery as affected by combination of vinasse and organic materials in wheat crops at harvesting in two successive seasons

This phenomenon could be explained by the fact that the total amount of inorganic NPK added within vinasse especially at application 2%.

Apparent Nutrients Recovery (ANR)

Macronutrients recovery indicated the percentage of element taken up by plant parts (straw and grain) to relative amount of fertilizer applied. Data in Fig. 1 show the effect of different combination of both vinasse and organic materials on ANR in wheat plant after harvesting.

Regardless either rate of organic materials application or wheat plant parts, the mean values of N and K recovery ,in general, increased gradually in all treatments, as well as the high value was obtained with VF. The treatments can be arranged as the following order VF> V> VHS>VH, such result may be due to the fulvic acid had high ion exchange capacity and function as plant hormone as reported by Akinci and Ongel (2011). Also, the increased in N and K uptake consequently increase the nutrients recovery. While P recovery was the same trend with VH treatment than other treatments that may be due to the VH was acidity in soil media resulting to enhancement P availability from soil to plant.

Soil Chemical Characteristic after Wheat Plant Harvested

Data in Table 5 revealed that the application of organic acids in combination with vinasse, as industrial waste, were generally decreased slightly both pH and EC in all treatments as compared to control. Also, by increasing rates of application both pH and EC values decreased. Ribeiro *et al.* (2012) reported that the decrease in pH may be due to the acidity of vinasse (pH = 3.5) initially contributes to increase H+ in soil solution and consequently, decrease the pH. For pH in all soils where when the clay fraction was treated with vinasse, the zeta potential was closed to 0, indicating that the soil charges were partially neutralized. Arafat and Yassen (2002) concluded that the application of vinasse had slight effect on soil pH due to the production of the organic acids and hydrogen ion (H^+). The decomposition process accelerates the release of CO_2 and organic acids that would reduce pH. Mohamed (2012) added that the EC value of the soil was lower in HA application rate compared to the untreated one of HA. However, the effect of application of dose (1.0 g kg^{-1}) was not significant compared with control. The EC values of soil decreased significantly with doses (2.0 and 3.0 g kg^{-1}) treatments. This could be due to the role of humic acid in improving soil aggregation and water movement leaching the excessive soluble salts.

On the other hand, the available N, P and K generally increased with VF treatment as compared to control and other treatments. Also, applied different rates of vinasse in combination with organic acids gradually increased N, P and K availability in soil especially with 40 L fad.$^{-1}$. The same trend was observed with OM content which increased in all treatments as compared to control treatment. Mahmoud *et al.* (2011) reported that organic matter was significantly increased upon the soil application of HA and progressed with increasing its rate from 15 to 30 kg HA/fad.

Status of Soil Anions and Cations

Results in Table 6 revealed that the saturation percent (SP) was slightly increased in all treatments either when vinasse was applied alone or in combination with humic materials (HA, FA and HS) in comparison to control treatment. Pena-Méndez *et al.* (2005) concluded that by increasing the application rate of organic materials, the SP values generally increased. The addition of humic acid also indirectly increase the reserves of H_2O in the soil because of its ability to absorb water becomes high.

With respect to different organic sources applied to sandy soil, some soluble cations and anions were affected as shown in Table 6. The obtained results reveal that generally Ca^{++}, K^+ and Na+ as cations and Cl^-, SO_4^- as anions increased slightly in all treatments as compared to control. On the other hand, HCO_3^- and Mg^{++} were decreased in all treatments applied either with vinasse separately or in combination with (HA, FA and HS). Meanwhile, no clear trend was observed with rate application of all investigated treatments.

Table 5. Effect of different rates of vinasse in combination with different organic acids on sandy soil chemical properties at two successive seasons

Organic conditioner	Rate of application (L fad.$^{-1}$)	First season pH (1:2.5)	First season EC (dS m^{-1})	First season OM (%)	First season Available macronutrients (mg kg^{-1}) N	P	K	Second season pH (1:2.5)	Second season EC (dS m^{-1})	Second season OM (%)	Second season Available macronutrients (mg kg^{-1}) N	P	K
		7.14	1.05	0.40	140	25.2	172	7.1	1.11	0.44	168	30.3	207
V	20	7.02	1.00	0.53	182	32.2	181	7.1	0.95	0.48	218	38.6	218
	30	6.98	0.72	0.56	182	29.9	214	7.0	0.73	0.56	218	35.8	258
	40	6.91	0.98	0.58	182	21.8	159	7.0	0.75	0.66	218	26.1	191
	Mean	6.97	0.93	0.56	168	27.9	185	7.04	0.81	0.57	202	33.5	222
VH	20	7.05	0.73	0.46	189	31.0	205	7.1	0.8	0.56	227	37.2	246
	30	7.02	0.86	0.54	140	46.7	277	7.1	0.95	0.57	168	56.0	334
	40	6.96	0.83	0.58	140	6.7	226	7.0	1.09	0.61	168	8.0	271
	Mean	7.01	0.81	0.53	153	28.1	236	7.08	0.95	0.58	188	33.7	283
VF	20	7.12	0.70	0.42	168	15.8	221	7.2	0.74	0.45	202	19.0	266
	30	7.02	1.30	0.54	175	28.3	232	7.1	0.98	0.57	210	34.0	279
	40	6.98	0.79	0.66	180	18.9	161	7.0	0.83	0.70	218	22.7	194
	Mean	7.04	0.93	0.54	170	21.0	205	7.11	0.85	0.57	210	25.2	246
VHS	20	7.07	0.95	0.47	140	18.5	182	7.1	0.78	0.49	168	22.2	219
	30	7.07	0.87	0.47	182	18.2	256	7.1	0.91	0.49	218	21.9	308
	40	6.97	0.76	0.51	172	26.4	202	7.0	0.70	0.60	207	31.7	243
	Mean	7.04	0.86	0.48	164	21.0	214	7.11	0.80	0.53	198	25.3	256
Mean of organic conditioners (A)	V	6.97	0.93	0.55	168	27.9	185	7.04	0.81	0.59	140	22.3	148
	VH	7.01	0,81	0.53	156	28.1	236	7.08	0.94	0.55	130	22.4	189
	VF	7.04	0.93	0.54	175	21.0	205	7.1	0.85	0.57	145	16.8	164
	VHS	7.04	0.86	0.48	164	21.0	214	7.1	0.79	0.50	137	16.8	171
	Cont.	7.04	1.03	0.39	182	25.2	172	7.1	1.11	0.45	151	20.1	138
Mean of rates (B)	20	7.06	0.88	0.45	163	24.5	192	7.13	0.88	0.48	136	19.6	154
	30	7.03	0.95	0.50	172	29.7	230	7.09	0.93	0.54	143	23.7	184
	40	6.97	0.89	0.55	171	24.5	184	7.04	0.89	0.58	142	15.8	147
LSD at 0.05%													
A (conditioner)		0.15	0.03	0.08	12.6	8.3	25.4	0.15	0.03	0.08	10.2	6.67	20.4
B (rates)		0.09	0,01	0.06	4.43	5.24	15.7	0.09	0.01	0.06	3.9	4.19	12.6
A × B		0.1	0.8	0.05	3.6	4.3	12.8	0.08	0.6	0.05	3.2	3.4	10.3

Table 6. Effect of different rates of vinasse and organic conditioner on status of anions and cations in sandy soil after plant harvesting

Organic conditioner	Rate of application (L fad.$^{-1}$)	SP	Anaions (meq L^{-1})				Cations (meq L^{-1})			
			CO_3^-	HCO_3^-	Cl^-	So_4^{--}	Ca^{++}	Mg^{++}	Na^+	K^+
Control		26.4	-	7.60	1.25	0.30	2.00	5.20	1.10	0.80
	20	27.7	-	6.42	1.50	1.33	2.25	3.75	1.85	1.4
V	**30**	28.4	-	5.14	1.65	0.72	1.75	2.75	1.65	1.35
	40	26.9	-	6.27	1.75	0.98	1.75	4.75	1.55	0.95
Mean		27.3	-	5.94	1.63	1.01	1.92	3.75	1.68	1.23
	20	27.5	-	5.53	1.00	1.27	3.00	2.50	1.20	1.10
VH	**30**	28.2	-	7.14	1.00	0.87	3.50	2.40	1.60	1.50
	40	27.7	-	6.99	1.50	0.77	3.00	3.80	1.50	0.95
Mean		27.8	-	6.55	1.17	0.97	3.17	2.90	1.43	1.18
	20	27.5	-	5.49	1.25	1.12	2.50	2.40	1.30	1.65
VF	**30**	27.2	-	8.25	1.50	1.2	3.00	3.50	1.40	3.05
	40	27.7	-	6.4	1.75	1.45	2.00	3.80	1.30	2.5
Mean		27.5	-	6.71	1.50	1.26	2.50	3.23	1.33	2.40
	20	28.7	-	6.14	1.50	0.82	2.25	3.15	1.15	1.95
VHS	**30**	26.3	-	6.03	1.25	1.62	2.75	3.45	1.55	1.15
	40	24.7	-	6.17	1.25	1.48	2.50	2.95	2.55	0.90
Mean		26.5	-	6.11	1.33	1.31	2.50	3.18	1.73	1.33

El-Desoky *et al.* (2010) stated that vinasse increased the available calcium in all studied soils. It may be attributed to its acidity that dissolves calcium carbonate as well as having some soluble organic components that are able to chelate and complex calcium. Humic acid came after vinasse in its ability to increase the available calcium of the studied soils. It caused substantial increases in the available Ca of the soils under study due to its high ability to chelate soil calcium because of its high alkalinity (pH11.66) whereas calcium chelates are stable. The behavior of humic acid can be attributed to the humic acid had adsorption site so the positive ions bound to oxidized site adsorption provide space for the entry of negatively charged molecules which causes them to absorb micronutrients (Tan, 2003 and Mikkelsen, 2005). Recently, Mindari *et al.* (2014) concluded that the humic acid material affected the value of exchangeable Na and K but did not significantly affect exchangeable Ca and Mg. Although the dose and type of humic acid only partially affected soil cations, there was a strong interaction between them on all the cations evaluated.

Conclosion

From the above mentioned results it can be concluded that the application of vinasse combined with other organic acids (humic acids, fulvic acids and humic substances) especially at

40 L fad.$^{-1}$ was generally more effective than application vinasse alone. These combinations of vinasse with organic acids lead to improve some chemical properties of sandy soil and nutrients availability in growth media which reflected on enhanced total contents of macronutrients and nutrient recovery in wheat crops.

Acknowledgment

The authoresses wish to express their sincere gratitude and appreciation to the Development of Soil Conditioners Project, Dept. of Physics and Chemistry of Soil, Soils, Water and Environ. Res. Inst., Agric. Res. Center (ARC), Giza, Egypt, for introducing all facilities needed to accomplish this study.

REFERENCES

Akinci, I. E and O. Ongel (2011). Nikelin fasülye (*Phaseolus vulgaris*) fide gelişimi üzerindeki toksisitesinin humik asit ile azaltılması. Ekoloji., 20: 29-37.

Anonymous (2010). Humic and fulvic acids: The black gold of agriculture? http://www. humintech. com/ pdf/humicfulvicacids.pdf (Access date: 10.08.2010).

Arafat, S. and A. E. Yassen (2002). Agronomic evaluation of fertilizing efficiency of vinasse. 17th WCSS August, Thailand.

Brunetti, G. (2007). Effects of amendment with treated and untreated olive oil mill waste waters on soil properties, soil humic substances and wheat yield". Jour. Geoderma 138: 144-152.

Cenellas, L.P., F.L. Olivares, A.L. O.F.A. Canha and A.R. Facanha (2002). Humic acids isolated from earthworm compost enhance root elongation, lateral root emergence and plasma membrane H-ATPase activity in maize roots. Plant Physiology, 130: 1951-1957.

Chen, Y. and M. Schnitzer (1978). Water surface tension of aqueous solutions of soil humic substances. Soil Sci., 125: 7-15.

Chen, Y., C.E. Clapp and H. Magen (2004a). Mechanisms of plant growth stimulation by humic substances: The role of organic-iron complexes. Soil Sci. and Plant Nutri., 50: 1089-1095.

Chen, Y., M. Nobili, and T. Aviad (2004b). Stimulatory effect of humic substances on plant growth. In: Magdoft F., Ray R. (Eds): Soil Organic matter in sustainable agriculture. CRC Press, Washington.

Cottenie, A., M. Verlso, L. Kilkens, G. Velghe and R. Camerlynck (1982). Chemical Analysis of Plant and Soils, Lab. Agroch., State Univ., Gent, Belgium.

El-Desoky, M.A., M. A. Faragallah, A. Ghallab and M. A. Hamed (2010). Addition effects of certain organic materials on some chemical properties and available calcium and phosphorus of Calcareous Soils.

Fageria, N. K. and V. C. Baligar (1997). Upland rice evaluation for phosphorus use efficiency. J. Plant Nut., 20: 499–509.

Gloria, N. (1985). Aplicacao de vinhacaao solo. 1er Encontrosobre Manejo do Solos. ESALQ. Piracicaba, 31.

Grenthe, I. and I. Puigdomenech (1997). Modeling in Aquatic Chemistry, Paris, Nuclear Energy Agency, OECD.

Haggag, L., F.M.F.M. Shahin, M. Afifi, H.A. Mahdy and N.S. Mustafa (2013). Optimizing fruit quality and quantity of "Aggizi" olive trees cultured in North Sinai by using some organic extracts. Middle East J. Appl. Sci., 3: 17-23.

Haggag, L.F., M.F.M. Shahin, N.S. Mustafa, H.A. Mahdy and H.S.A. Hassan (2015). Studies on the effect of vinasse, amino acids and humic acid substances as soil applications on fruit quality and quantity of manzanillo olive trees. Middle East J. Appl. Sci., 5 : 984-991.

Mackowiak, C.L., P.R. Grossl and B.G. Bugbee (2001). Beneficial effects of humic acid on micronutrient availability to wheat. Soil Sci. Soc. Amer. J., 56: 1744-1750.

Mahmoud, M.M., A.H.A. Hassanein, S.F. Mansour and A.M. Khalefa (2011). Effect of soil and foliar application of humic acid on growth and productivity of soybean plants grown on a calcareous soil under different levels of mineral fertilizers. J. Soil Sci. and Agric. Eng., Mansoura Univ., 881 – 890.

Mayhew, L. (2004). Humic substances in biological agriculture, Part 1. In Acres USA. Fred C. Walters, Austin, Texas, 34.

Mikkelsen, R.L. (2005). Humic materials for agriculture. Better Crops, 89 : 6-10.

Mindari, W., N. Aini, Z. Kusuma and S. Yekhfani (2014). Effects of humic acid-based buffer + cation on chemical characteristics of saline soils and maize growth. J. Degraded and Min. Lands Manag., 2: 259-26.

Mohamed, W.H. (2012). Effects of humic acid and calcium forms on dry weight and nutrient uptake of maize plant under saline condition. Aust. J. Basic and Appl. Sci., 6: 597-604.

Muhammed, Y.K., T.M. Muhammed, A.B. Mushtaq and M.J. Taj (2012). Effect of spent wash of ethanol industry on groundwater. A case study of Rahimayar Khan district. Pak. J. Environ. Sci. Water Res. 85-94.

Page, A.L., R.H. Miller and D.R. Keeny (1982). Methods of Soil Analysis Part 2 Chemical and Microbiological Properties. 2nd Ed. ASS. A-Midison Wise, USA.

Pettit, R.E. (2004). Organic matter, humus, humate, humic acid, fulvic acid and humin: their importance in soil fertility and plant health [Online]. Available at www. humate. info/ mainpage.htm.

Peña-Méndez, E.M., J. Havel and J. Patočka (2005) Humic substances. compounds of still unknown structure: applications in agriculture, industry, environment, and biomedicine. J. Appl. Biomed., 3 : 13 – 24.

Quanbao, Y., Z. Hongcheng, W. Haiyan, Z. Ying, W. Benfo, X. Ke, H. Zhongyang, D. Qigen and X. Ke (2007). Effects of nitrogen fertilizer on nitrogen use efficiency and yield of rice under different soil conditions. Agric. China, 1: 30-36.

Radwan, F.I., M.A. Gomaa, I.F. Rehab and S.I.A. Adam (2015). Impact of humic acid application, foliar micronutrients and biofertilization on growth, productivity and quality of wheat (*Triticum aestivum*, L.) Middle East J. Agric. Res., 2 : 130-140.

Ribeiro, B.T., J.M. de lima, N. Curi and G.C. de Oliveira (2012). Electrochemical attributes of soils influenced by sugarcane vinasse. Biosci. J., Uberlândia, 28 (1): 25-32.

Sajbrt, V., M. Rosol and P. Di (2010). A comparison of distillery stillage disposal methods. Acta Polytechnica, 50 : 2.

Saruhan, V., A. Kusvuran and S. Babat (2011). The effect of different humic acid fertilization on 49. Datta, K.S. and K.K. Novenytermeles, 60: 279-282.

Schnitzer, M. and S.U. Khan (1972). Humic substances in the environment. Dekker Publ. New York, NY. 9-23.

Snedecor, C.W. and W.G. Cochran, (1980). Statistcal Method. 7th Ed. Iowa State Univ. Press, Ames, USA.

Seyedbagheri, M. (2010). Influence of humic products on soil health and potato production. Potato Res., 53: 341-349.

Shahin, M.F.M., E.A.E. Genaidy and L.F. Haggag (2015). Impact of amino acids, vinasse and humic acid as soil application on fruit quality and quantaty of "kalamata" Olive Trees. Int. J. Chem. Tech. Res. Coden (USA): Ijcrgg. 8 (11): 75-84.

Sharaf El-Din, M.N., O.M. Abd El-Kafie, S.Z. El-Bably and A.N. Aboukamar (2011). Effect of fulvic acid extract and chemical fertilization on *Pancritium maritimum*. J. Plant Prod., Mansoura Univ., (8):1037-1045.

Tan, K.H. (2003). Humic matter in soil and environment, principles and controversies. Marcel Dekker, Inc., Madison, New York.

Van Schoor, L., P.J.C. Stassen and A. Botha (2012). Effect of organic material and biological amendments on pear tree performance and soil microbial and chemical properties. Acta Hort. (ISHS) 933: 205-214 http://www.actahort.org/books/933/933_24.htm.

إنتاجية محصول القمح في الأراضي الرملية المعاملة بمركبات من الفيناس مع الأحماض العضوية

وفاء محمد العتر – هناء عطية زين العابدين

معهد بحوث الأراضي والمياه والبيئة - مركز البحوث الزراعية- الجيزة - مصر

أجريت تجربة حقلية لمدة موسمين شتويين متعاقبين في محطة البحوث الزراعية بالإسماعيلية، مصر، لتقييم إمكانية استخدام الفيناس منفرد أو مخلوط مع بعض الأحماض العضوية لتحسين حالة العناصر الغذائية في التربة الرملية وانعكاسه على إنتاجية محصول القمح صنف (جيزة ١٦٨)، صممت التجربة في تصميم قطع منشقة مرة واحدة مع ثلاثة مكررات، وقد تضمنت التجربة خمس معاملات رئيسية وهي الكنترول (المعدل الموصي به من NPK)، الفيناس (V)، الفيناس وحمض الهيوميك (VH)، الفيناس وحامض الفلفيك (VF) ، الفيناس والمواد الهيومية .(VHS) أما المعاملات الفرعية تشمل المعدلات المختلفة لكل معاملة وهي (صفر، ٢٠، ٣٠ و ٤٠ لتر فدان-١)، تم إضافة كافة المعاملات للتربة الرملية ثلاث مرات عند ٣٠ ، ٤٥ ، ٦٠ يوما خلال موسمي الزراعة، وأوضحت النتائج أن محصول القمح (القش والحبوب) بالإضافة إلى المحتوى الكلي من N ، P و K بصفة عامة قد زاد زيادة معنوية عند إضافة VF وذلك مقارنة بالكنترول والمعاملات الأخرى، علاوة على ذلك، فان قيم محصول نبات القمح قد زادت بزيادة نسبة إضافة الفيناس مع أي من الأحماض العضوية بالمقارنة بإضافة الفيناس منفردا وكان أفضل معدل إضافة هو٤٠ لتر /فدان، من ناحية أخرى فان إضافة بعض المحسنات العضوية أدى إلى انخفاض طفيف لكل من قيم pH، EC مقارنة بالكنترول، كما لوحظ اتجاه مختلف نسبيا مع المادة العضوية حيث زادت قيم OM زيادة معنوية في كل المعاملات المضافة مقارنة بالكنترول، وأيضاً زادت نسبة العناصر الكبرى الميسرة في التربة تدريجيا مع زيادة معدلات إضافة المحسنات العضوية، بصفة عامة وجد أن إضافة الفيناس مع الأحماض العضوية الأخرى (حمض الهيوميك، حمض الفلفيك، المواد الهيومية) ساعد في رفع إنتاجية نبات القمح وإجمالي محتواه من العناصر الغذائية الرئيسية بالإضافة إلى تحسين بعض الخواص الكيميائية للتربة الرملية محل الدراسة في هذا البحث.

المحكمون :

١- أ.د. محمد جودة محمد أحمد خليل أستاذ علوم الأراضي – كلية التكنولوجيا والتنمية – جامعة الزقازيق.

٢- أ.د. السيد عوض محمـــد عوض أستاذ علوم الأراضي المتفرغ – كلية الزراعة – جامعة الزقازيق.