Journal of Soil Sciences and Agricultural Engineering

Journal homepage: www.jssae.mans.edu.eg
Available online at: www.jssae.journals.ekb.eg

Response of Onion Plants Productivity and Quality to Tow Organic Polymers under Sustainable Mineral Fertilizers Management

Hayam A. El –Shaboury* and Magda A. Ewais

Soils, Water and Environ. Res., Inst., Agric. Res. Center, Giza, Egypt

ABSTRACT

Two field experiments were carried out during the winter seasons of 2017/2018 and 2018/2019 at a private farm (Tanboul El-Kobra), Al-Senbilawin, Dakahlia Governorate, Egypt. The present study was conducted to evaluate the influence of soil drench of tow organic polymers (Humic acids as K- humate (HAs) and Falvic acids as K-fulvate (VAs) alone or incorporated together under different rates of N, P and K fertilization on onion plants growth, yield, and its components and quality of bulbs (*Allium cepa* L.) cv. Giza Red. The treatments were arranged in a split-plot design with three replicates. Results indicated that 100% NPK treatment followed by 75% then 50% significantly increased all determined traits under the study contentions. Soil application of HAs and VAs was superior for on vegetative growth parameters, bulbs productivity, chemical constituents, and quality compared to the control (without applications). Under 75% NPK, in combination, the duel application of HAs and VAs showed a significant augmentation in all studied parameters compared to the control under 50, 75 .and 100% of the recommended mineral fertilization. Therefore, the application of HAs and VAs by soil drench in combination treatment with 75% NPK is important for improving plant quality and reducing environmental pollution due to partial replacement of mineral fertilizer with HAs and VAs.

Keywords: K-humate, K-fulvate, onion, nutrient uptake, Vegetative Growth.

INTRODUCTION

Onion (*Allium cepa* L.) is one of the most important vegetable crops grown in Egypt, not only for local consumption but also for exportation. It is ranked the third most important vegetable crop after tomato and potato in Egypt which is the 9th onion producer in the world and in 2017 onion production area was 68057 ha with a total production of 2'379'035 tons with an average yield of about 36 t.ha^{-1} (FAO, 2017). Also, Egyptian onion varieties distinguish with high quality due to its high nutritional value and pungency therefore, it has a high potential for exportation. Onion is considered one of the major sources of hard currency due to the early maturity and the possibility of the early exports to European markets.

It is known that nitrogen, phosphorus, and potassium, play pivotal roles in plant growth and development. N plays an important role to reach the optimum yield of onion and is found essential to increase the bulb size and yield as well as increasing dry weight of the bulb and nitrogen content (Khan *et al.*, 2002). The presence of phosphorus in the soil encourages plant growth because the phosphorus is an essential nutrient and a major building block of DNA molecules (Pant and Reddy, 2003). El Dardiry *et al.*, (2015) reported that the phosphorus fertilizer had a major effect on the productivity of an onion plant, hence increased total bulb yield and its components.

It may be attributed to the enhancement of phosphorus on the plant growth and it's reflected on the bulbs yield. Many investigators had obtained a similar trend of results (Ali *et al.*, 2001 and Al-Moshileh, 2001). Potassium is necessary for the translocation of sugars and formation of carbohydrates.

Humic acid contains many elements and it acts as an amendment to improve soil fertility. This increases the availability of nutrients and consequently, it increases plant growth and yield. Humic acid particularly is used to ameliorate or reduce the side effect of chemicals. Humic acid application increased organic matter in soil which improved plant growth and yield (El-Desuki., 2004). Humic substances are able to capture more moisture content that will increase the water use efficiency in the sandy soil. This may be attributed to the swelling and retention of water by the amended soil (Suganya and Sivasamy, 2006). Humic acid efficiently improves soil fertility and crop productivity (Rajpar *et al.*, 2011). Humic acid affects the chemical and biological properties of soil as well as the morpho-physiological processes of a plant.

Fulvic acid is considered to play an important role in retention and release, biological availability, and mobility of macro- and micronutrients and organic chemicals in soil (Hu, *et al.*, 2019). Fulvic acid has maximum influence on chemical reactions because of the presence of more electronegative oxygen atoms than any other humate molecules, which enhances membrane permeability (Priya *et al.*, 2014). Fulvic materials can affect physiological processes of plant growth directly or indirectly could improve plant growth under soil condition by enhancing the uptake of nutrients and reducing the uptake of some toxic elements (Kulikova *et al.*, 2005). Anjum *et al.*, (2011) reported that fulvic acid

* **Corresponding author.**
E-mail address: hayamelshaboury@yahoo.com
DOI: 10.21608/jssae.2020.125019

increased chlorophyll and water content of leaves. It also increased photosynthesis, reduced stomata opening status, and transpiration, thus led to growth stimulation and water loss reduction. Many beneficial effects are attributed to foliar or soil application of potassium fulvate (KF), including stimulation of plant metabolism, increased enzyme activity (transaminase, invertase), increased bioavailability and uptake of nutrients, and increased crop growth and yield.

Therefore, the present study aims to investigate the potential of K- humate and fulvate as "organic fertilization" separately and in combination on reduces the requirement of mineral fertilization, enhanced nutrient uptake and productivity of onion.

MATERIALS AND METHODS

Field Experiments

Two field experiments were conducted at a private farm (Tanboul El-Kobra), Al-Senbilawin, Dakahlia Governorate, Egypt, (31º 11' 33.43'E, 30º 1' 36.16' N) in the two successive winter seasons of (2017/2018 and 2018/2019) to evaluate influence of soil drench of tow organic polymers (Humic acids as K-Humate (HAs) and Falvic acids as K-Fulvate (VAs) as "organic fertilization" separately and in combination under different rates of NPK fertilization on plant growth, yield, and quality of onion plants (*Allium cepa* L.) cv. Giza Red. The experiment was laid out in a split-plot design in a complete randomized block design with three replications. Treatments included three rates of soil application of NPK fertilizers (100% traditional recommended dose (RFD), 75% RFD and 50% FRD) in the main plots and four applications of organic polymers included (without, HAs, VAs and HAs + VAs) were applied in the sub plots. Each plot (experimental unit) had five ridges, each of 0.6 m in width and 3.5 m in length, occupying an area of 10.5 m^2. All agronomic practices were keeping normal and uniformed for all the treatments. Seeds of onion (*Allium cepa* L.) cv Giza Red were sown in the nursery on October $15^{th}$and 18^{th} in the first and second season respectively. After 60 days, uniform healthy seedlings were transplanted at 10 cm apart on both sides of the ridges. Transplants were placed on both sides of the ridge at 7 cm between the plants. The recommended doses, of N and K fertilizers for onion plants were 120 kg N/fed and 24 kg K_2O /fed.

The nitrogen fertilizer as ammonium sulfate (20.6 % N) was added according to the treatment in three equal doses after 4,6 and 8 weeks from transplanting date and potassium sulfate (48 % K_2O) was applied twice, one half with the first dose and the second half with the third dose of N fertilizer. Also, phosphorus fertilizer was applied in the form of calcium superphosphate (15 % P_2O_5) once during soil preparation at the rate of 45 kg P_2O_5 fed^{-1}. Potassium humate (HAs) and Fulvate (VAs) were applied to the soil drench at three times 20 days after transplanting and every 20 days with freshly prepared solutions *at al* concentration of 5 ml l^{-1} individually or in combination. The elementary composition of HAs and VAs is presented in Table (1)

Table 1. Chemical analysis of the two organic polymers (HAs and VAs).

Elements	Potassium humate	Potassium fulvate
pH	8.50	3.29
EC,dSm^{-1}	52.70	55.50
O. M (%)	21.98	14.48
C%	12.75	8.40
C/N	7.33	11.05
Macro elements (%)		
N	1.74	0.76
P	0.27	0.14
K_2O	10.00	10.00
Micro elements (mg kg^{-1})		
Fe	105	74.60
Zn	2.75	11.40
Mn	1.49	1.85
Cu	0.40	0.27

Soil Analytical Procedures

A composite soil samples were collected from 0-30, cm depth during the 2 years of the study (2017/2018 and 2018/2019) before planting and were prepared for analyses in laboratory. Soil physical, chemical, and nutrients status of the experimental site were determined according to Page *et al.,* (1982) and Klute (1986) as shown in Table(2).

Table 2. some physical and chemical properties of the experimental soil.

Soil characters		Growing Season 1 st	Growing Season 2 nd
Practical size distribution (%)	Coarse sand	3.77	3.68
	Fine sand	22.14	21.97
	Silt	44.74	44.83
	Clay	29.35	29.52
	Texture class	Clay loam	Clay loam
EC (dSm^{-1}) (1:5)		0.93	0.96
pH (1:2.5)		7.89	7.87
S.P (%)		62.3	60.7
Organic matter g kg^{-1}		1.65	1.61
$CaCO_3$ (%)		2.59	2.46
Soluble ions meq L^{-1} (1:5 soil : water extract)			
Cations			
Ca^{++}		3.10	2.87
Mg^{++}		1.62	1.57
Na^{+}		4.26	4.30
K^{+}		0.34	0.39
Anions			
CO_3^{--}		0.00	0.00
HCO_3^{-}		1.86	1.82
Cl^{-}		3.49	3.31
$SO4^{-}$		3.97	4.00
Available macro and micro-nutrients (mg kg^{-1})	N	49.6	49.2
	P	5.91	5.88
	K	179.5	181.3
	Fe	3.05	2.97
	Zn	0.86	0.85
	Mn	1.39	1.37

Collection of Experimental Data

At 90 days after planting a random sample of ten plants from each experimental unit was taken and the following data were recorded:

Plant growth characters:

a. Morphological characters:

Plant height (PH) ,cm, number of leaves/plant (NLP), fresh and dry weight of leaves (LFW, LDW) and bulb as well as the total fresh and dry weight (BFW, BDW) of whole plant, chlorophyll (a, b and (a + b)) and carotene (mg g^{-1} FW) in leaves according to the method of Witham *et al.,* (1971) and also, at the same time, the sample concentrations of N, P, K, Fe, Zn and Mn were determined.

b. Yield and its components:

At the proper maturity stage of bulbs in every experimental plot were harvested, then moved to a shady place on the same day for curing. The following yield parameters were determined as follow, bulb height BH, cm; neck diameter ND,cm/plant, bulb diameter (BD), cm; average bulb weight (ABW), g and total yield of bulb (TBY), ton fed^{-1}.

c. Bulb quality at harvest time:

Dry matter percentage (DM), %: It was determined at harvest using 100 g. fresh bulbs oven dried at 105 ºC till constant weight, in fresh bulbs (juice), the total soluble solids (T.S.S) were estimated using handle refract meter, total N and P was determined using the method described by (A.O.A.C 1990), whereas K content was determined according to Cottenie *et al*., (1982). The content of Fe, Zn, and Mn was determined in the wet digested samples as described by Chapman and Paratt (1961). Total carbohydrates content (TC) in onion bulbs was determined according to the method of Dubois *et al.,* (1956). Total, reducing and non-reducing sugars contents (TS) in onion bulbs were determined according to Somogy (1952).

Finally Vitamin-C content (V.C) [Ascorbic acid] it was determined according to the method reported in A.O.A.C (1990).

Statistical analysis:

Results for all studied parameters were statistically analyzed using the combined 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 significance.

RESULTS AND DISCUSSION

I- Vegetative Growth

A- Effect of mineral fertilizers application

Data presented in Tables (3 and 4), show the different measurements of vegetative growth. It is clear that Chlorophyll content (ChlC) , PH, NLP, FW and DW were significantly increased with increase application level NPK (RFD). The obtained data clearly demonstrated the significant response vegetative growth parameters to increasing the levels of mineral fertilizers application from 50, 75 up to 100% of the recommended dose of onion fertilization. The highest values of all parameters under study were recorded at the rate of 75 or 100% NPK of RFD. The data also exhibited a significant increase in leaf total chlorophyll content with increasing the application rate of NPK from RFD up to 100%. These findings revealed a positive correlation between ChlC and NPK fertilization. This increase in ChlC might be due to the increase in macronutrient uptake, especially N and Mg, are necessary for chlorophyll synthesis. Many investigators reported that the vegetative growths of onion plants and minerals uptake were increased with increasing the level of NPK-fertilizers (EL-Desuki and Sawan 2001). It is known that N, P, and K fertilization, play pivotal roles in plant growth and development. Nitrogen plays an important role to reach the optimum yield of onion and is found essential to increase the bulb size and yield as well as increasing dry weight of the bulb and nitrogen content (Khan *et al.,* 2002). The presence of phosphorus in the soil encourages plant growth because the phosphorus is an essential nutrient and a major building block of DNA molecules (Pant and Reddy, 2003). El Dardiry *et al.,* (2015) reported that the phosphorus fertilizer had a major effect on the productivity of the onion plant, hence increased total bulb yield and its components. It may be attributed to the enhancement of phosphorus on the plant growth and it's reflected on the bulbs yield. Many investigators had obtained a similar trend of results (Ali *et al.,* (2001) and Alkaff *et al.,* 2002).

On the other hand, potassium is necessary for the activation of some enzyme systems, carbohydrates metabolism and/or formation and translocation of carbohydrate, control, and regulation of activities of various essential elements. Therefore, N, P, and K enhance the amount of metabolites necessary for building plant organs consequently vegetative growth of the plant.

Table 3. Effect of different levels from NPK RFD and HAs and VAs, on chlorophyll content (averaged over the two growing seasons).

Treatments		Chl. a (mg g^{-1} FW)	Chl. b (mg g^{-1} FW)	Chl. a+b (mg g^{-1} FW)	carotenoids (mg g^{-1} FW)
NPK RFD levels					
50% RFD		0.523	0.367	0.890	0.757
75% RFD		0.532	0.373	0.905	0.766
100% RFD		0.542	0.381	0.923	0.780
L.S.D.at 5%		0.003	0.002	0.003	0.002
Application of organic polymers (HAs and VAs)					
Control		0.532	0.374	0.91	0.768
Has		0.641	0.458	1.10	0.901
Vas		0.586	0.416	1.00	0.836
HAs+VAs		0.657	0.498	1.19	0.967
L.S.D.at 5%		0.002	0.002	0.002	0.003
Interaction of NPK RFD levels and Organic polymers (HAs and VAs)					
50% RFD	Control	0.523	0.367	0.89	0.757
	HAs	0.637	0.451	1.088	0.890
	FAs	0.577	0.409	0.986	0.825
	HAs + VAs	0.685	0.491	1.176	0.955
75% RFD	Control	0.532	0.373	0.905	0.766
	HAs	0.638	0.458	1.097	0.902
	FAs	0.585	0.416	1.001	0.836
	HAs + VAs	0.694	0.500	1.194	0.968
100% RFD	Control	0.542	0.381	0.924	0.780
	Has	0.647	0.464	1.111	0.912
	FAs	0.595	0.422	1.016	0.847
	HAs + VAs	0.701	0.502	1.203	0.977
L.S.D.at 5%		n.s.	n.s.	n.s.	n.s.

50%, 75% and 100% of Recommended NPK fertilizers does (RFD) HAs and VAs as tow organic polymers of K humate and falvate

B-Effect of HAs and VAs applications

Both of K- humate (HAs) and fulvate (VAs) as a soil drench significantly increases onion plants growth characteristics. Generally, data in Tables (3 and 4) revealed that the ChlC, PH, NLP, FW and DW were improved significantly by using either HAs or VAs as compared with control treatment. The results clearly indicated that using mixtures of HAs+VAs gave the highest vegetative growth characters followed by using HAs then VAs but the lowest were recorded with control treatment. The increases in photosynthetic pigments content due to mixtures of HAs+VAs application are in agreement with those obtained by Ameri and Tehranifar (2012); Bakry *et al.,* (2013) and El-Bassiouny *et al.,* (2014). This positive HAs+VAs on photosynthetic pigments could be attributed to an increased in CO_2 assimilation and the photosynthetic rate which increased mineral uptake by the plant (Ameri and Tehranifar, 2012). This increment in vegetative growth may be attributed to the enhancing effect of humic acid on the availability of nutrients and the role of potassium in plant nutrition which in turn increased the vegetative growth of onion plants (Mahmoud and Hafez, 2010). Also, Fulvic acid when applied to the soil, it converted into readily available humic substances which directly or indirectly improve the plant growth (Lotfi *et al.*, 2015).

Table 4. Effect of different levels from NPK RFD and HAs and VAs, on vegetative growth parameters (averaged over the two growing seasons).

Treatments		PH, cm	NLP	FW (g plant^{-1})		DW (g plant^{-1})	
				Leaves	Bulb	Leaves	Bulb
NPK RFD levels							
50% RFD		71.73	6.16	58.47	16.24	5.07	1.62
75% RFD		75.52	6.65	61.33	18.03	5.40	1.85
100% RFD		76.95	7.26	63.06	20.92	5.75	2.13
L.S.D.at 5%		0.13	0.074	0. 721	0.814	0.183	0.044
Application of organic polymers (HAs and VAs)							
Control		74.73	6.69	60.95	18.40	5.41	1.87
HAs		79.29	8.16	68.60	23.59	6.28	2.57
VAs		77.41	7.50	65.58	20.61	5.84	2.15
HAs+VAs		81.37	9.51	72.94	27.12	6.82	3.07
L.S.D.at 5%		0.122	0.045	1.172	0.511	0.224	0.036
Interaction of NPK RFD levels and Organic polymers (HAs and VAs)							
	Control	71.73	6.16	58.47	16.24	5.07	1.62
50%	HAs	77.50	7.86	64.52	21.19	5.81	2.19
RFD	FAs	75.84	7.00	62.82	18.35	5.45	1.87
	HAs + VAs	80.11	8.76	69.09	24.00	6.41	2.43
	Control	75.52	6.65	61.33	18.03	5.4	1.85
75%	HAs	80.00	8.25	69.98	23.87	6.46	2.61
RFD	FAs	77.73	7.69	66.29	21.42	5.95	2.21
	HAs + VAs	81.85	9.83	74.51	27.98	6.98	3.29
	Control	76.95	7.26	63.06	20.92	5.75	2.13
100%	HAs	80.37	8.37	71.3	25.72	6.57	2.91
RFD	FAs	78.66	7.81	67.62	22.05	6.13	2.37
	HAs + VAs	82.15	9.94	75.23	29.38	7.07	3.48
L.S.D.at 5%		0.23	0.12	n.s.	n.s.	n.s.	0.012

50%, 75% and 100% of Recommended NPK fertilizers does (RFD)
HAs and VAs as tow organic polymers of K humate and falvate

C- Effect of the interaction treatments

Data in Tables (3 and 4) show the effect of the interaction treatments between levels of RFD and tow organic polymers application on the vegetative growth of onion plants. Results clearly indicated that all vegetative growth parameters (ChlC a, b, and the total ChlC of leaves, PH, NLP, FW and DW of the whole plant, and its different organs in onion) were the highest affected by the interaction treatments. The application of 100% NPK RFD in combination with organic polymers (HAs+VAs) gave more the highest vegetative growth parameters, while the lowest values of vegetative growth were recorded by applying 50% RFD without organic polymers (control).

These results may be attributed to insufficient nutrition according to decreasing fertilization level under condition of absence enhancing effect of organic polymers. These findings are in good agreement with that achieved by Eyheraguibel, *et al.*, (2008) who noticed that the humic substances were effective on plant growth and inorganic nutrition, seedling growth, root growth, shoot development, and the uptake of nutrients.

2-Nutrients Concentration and Uptake

A- Effect of mineral fertilizers application

Tables (5 and 6) showed that the macro- and micronutrients concentration values of onion leaves and bulbs, i.e. N, P, K, Fe, Zn and Mn, contents and uptake were affected by the application of N, P, and K fertilizers at with the different tested rates. The results showed that nutrients concentration and uptake in leaves and bulbs of onion were significantly increased when onion plants received a higher rate of N, P, and K fertilization rate (100% RFD) when compared with the lower rate (50% RFD). Concerning the effect of N, P and K application, the data revealed that the application of 100% NPK gave the highest significant values of N, P, K, Fe, Zn, and Mn contents followed by 75% RFD.

In this respect, such increments in the percentage of N, P, and K in onion plants refers to NPK mineral fertilizers may be attributed to the increase in soil concentration of such macronutrients as a result fertilization process in the root zoon which led to increasing the amounts absorbed by plant roots (El-Zohery, 2003). The obtained results are in good accordance with Nasreen *et al.,* (2007) and Shaheen *et al.,* (2011).

Mineral fertilizers play an important role in onion plant growth and productivity. Nitrogen is essential for the synthesis of chlorophyll, enzymes, and proteins. Phosphorus is essential for root growth, phospho-proteins, phospholipids and ATP, ADP formation. Potassium plays an important role in the promotion of enzymes activity and enhancing the translocation of assimilates and protein synthesis (EL-Desuki *et al.,* 2006).

Table 5. Effect of different levels from NPK RFD and HAs and VAs, on macro- and micronutrients concentration in onion leaves (averaged over the two growing seasons).

Treatments		Macronutrients in leaves (%)			Micronutrients in leaves (mg kg^{-1})		
		N	P	K	Fe	Zn	Mn
NPK RFD levels							
50% RFD		1.90	0.171	1.42	42.02	16.6	29.38
75% RFD		2.04	0.178	1.51	42.20	16.73	29.52
100% RFD		2.16	0.188	1.62	42.39	16.85	29.71
L.S.D.at 5%		0.022	0.002	0.031	0.077	0.078	0.032
Application of organic polymers (HAs and VAs)							
Control		2.03	0.179	1.52	42.20	16.73	29.54
HAs		3.11	0.271	2.47	44.18	18.19	31.21
VAs		2.59	0.226	1.99	43.23	17.50	30.43
HAs+VAs		3.67	0.319	2.96	45.19	18.92	32.03
L.S.D.at 5%		0.026	0.004	0.026	0.055	0.101	0.035
Interaction of NPK RFD levels and Organic polymers (HAs and VAs)							
	Control	1.90	0.171	1.42	42.02	16.60	29.38
50%	HAs	3.01	0.264	2.39	44.03	18.06	31.08
RFD	FAs	2.50	0.218	1.91	43.08	17.46	30.28
	HAs+VAs	3.56	0.311	2.87	45.02	18.8	31.87
	Control	2.04	0.178	1.51	42.20	16.73	29.52
75%	HAs	3.11	0.271	2.47	44.19	18.19	31.20
RFD	FAs	2.59	0.225	2.00	43.25	17.47	30.44
	HAs+VAs	3.67	0.32	2.98	45.19	18.90	32.04
	Control	2.16	0.188	1.62	42.39	16.85	29.71
100%	HAs	3.22	0.279	2.55	44.33	18.31	31.36
RFD	FAs	2.68	0.234	2.06	43.35	17.56	30.57
	HAs+VAs	3.77	0.326	3.04	45.36	19.05	32.17
L.S.D.at 5%		n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

50%, 75% and 100% of Recommended NPK fertilizers does (RFD)
HAs and VAs as tow organic polymers of K humate and falvate

B-Effect of soil application of HAs and VAs

Data in Tables (5 and 6) showed both macro- (N, P, and K) and micronutrients (Fe, Zn and, Mn) concentrations and uptake in onion leaves and bulbs as affected with application of HAs and VAs (K- humate or and fulvate) showed significant increases when compared to untreated control plants. Treatments could be arranged in the following order regarding the effects HAs + VAs > HAs > VAs > control under the various level of NPK of the recommended rates (RFD). K- humate and fulvate produced the highest values of macro (N, P, and K) contents and uptake followed ranks with potassium humate followed by fulvate while the control treatment gave the lowest values of these nutrients. The combined treatment (HAs + VAs) was found to be most effective on a macro (N, P, and K) concentrations and uptake. At this treatment, the relative increases over the control were (80.79%, 123.41%), (78.21%, 132.38%) and (94.74%, 143.46%) for N, P, and K concentrations and uptake, respectively. As with HAs and VAs also improved the chemical properties of soils because it increased the number of soil microorganisms which enhance nutrient cycling (Delfine *et al.,* 2005) and reduced soil pH thus increasing the availability of mineral nutrients to be absorbed by plant roots. Humic acid also promoted plant growth through its effects on ion transfer at the root level by activating the oxidation-reduction state of the medium and increasing the absorption of nutrients by preventing their precipitation in the nutrient solution. The increase in soil nutrients caused by the combined application of K- humate + fulvate was positively reflected in the nutrient composition of the onion plants. Moreover, the optimum leaf nutrient composition obtained due to application of HAs+Vas could be explained by the improved availability of essential nutrients in the root zone, resulting from their solubilization caused by the release of organic acids. Enhanced uptake of micronutrients such as Fe, Zn, Cu, and Mn was also found. Humic substances enhance the uptake of nutrients through the stimulation of microbial activity (Mayhew, 2004). Leaves micronutrient contents took trends similar to those attained with macronutrients as affected by applied with some organic acids. These results might be attributed to the favorable effect of potassium humate and fulvate together that easily binds or chelate minerals such as iron, calcium, copper, zinc, and magnesium, as it can deliver these elements to plant directly (Malan, 2015 and Lotfi *et al.,* 2015). Similar results with fulvic acid as soil conditioner has been reported by Taha *et al.,* (2016) and Mostafa *et al.,* (2017).

C- Effect of the interaction treatments

Data in Tables (5 and 6) showed the effect of interaction between tow organic polymers under three levels of N, P, K on both macro (N, P, and K) and micronutrients (Fe, Zn, and, Mn) contents in leaves and uptake in bulbs. The addition of various humic substances caused a positive significant effect on both macro- and micronutrients (Fe, Zn and, Mn) contents and uptake in onion leaves and bulb. The highest values of N, P, and K contents and uptake were obtained with dual application of HAs + VAs combined with 75 or 100% NPK of the recommended rates (RFD). However, untreated plants showed the lowest N, P, and K content. Treatments could be arranged in the following order regarding the effects HAs + VAs > HAs > VAs > control under the various level of NPK of the recommended rates. NPK contents and uptake in onion leaves and bulbs were significantly enhanced by the application of either potassium humate or fulvate and the maximum values were recorded when the plants were treated with a mixture of potassium humate and fulvate together (HAs+VAs). Leaves and bulbs micronutrient contents took trends similar to those attained with macronutrients as affected by application of tow organic polymers under the three tested levels of NPK

Table 6. Effect of different levels from NPK RFD and HAs and VAs, on macro- and micronutrients uptake of onion bulbs (averaged over the two growing seasons).

Treatments		Macronutrients- uptake, kg fed^{-1}			Micronutrients– uptake, g fed^{-1}		
		N	P	K	Fe	Zn	Mn
NPK RFD levels							
50% RFD		34.02	3.11	25.59	40.50	11.92	9.19
75% RFD		37.31	3.42	28.68	43.26	12.83	10.11
100% RFD		42.18	3.95	33.40	47.74	14.31	11.51
L.S.D.at 5%		1.367	0.192	0.720	0.542	0.297	0.203
Application of organic polymers (HAs and VAs)							
Control		37.84	3.49	29.22	43.84	13.02	10.27
Has		65.52	6.30	55.64	56.81	19.47	17.47
Vas		49.92	5.23	41.00	49.31	15.87	13.42
HAs+VAs		84.54	8.11	71.14	65.15	23.61	22.22
L.S.D.at 5%		1.816	0.172	0.726	0.910	0.261	0.228
Effect of the interaction							
50% RFD	Control	34.02	3.11	25.59	40.50	11.92	9.19
	HAs	59.50	5.85	50.80	53.13	18.06	16.00
	VAs	45.18	4.27	36.45	45.43	14.46	12.12
	HAs+VAs	77.09	7.40	63.73	60.72	21.83	20.34
75% RFD	Control	37.31	3.42	28.68	43.26	12.83	10.11
	HAs	66.40	6.38	56.27	57.62	19.73	17.71
	VAs	49.81	4.75	41.06	49.47	15.88	13.43
	HAs+VAs	85.17	8.23	72.42	65.88	23.91	22.38
100% RFD	Control	42.18	3.95	33.40	47.74	14.31	11.51
	HAs	70.66	6.68	59.85	59.69	20.62	18.69
	VAs	54.79	5.23	45.48	53.03	17.26	14.72
	HAs+VAs	91.36	8.71	77.27	68.86	25.10	23.95
L.S.D.at 5%		1.915	0.199	1.393	1.137	0.381	0.343

50%, 75% and 100% of Recommended NPK fertilizers does (RFD)
HAs and VAs as tow organic polymers of K humate and falvate

3- Yield and its components

A- Effect of mineral fertilizers application

Data presented in Table (7), reveal the effect of N, P, and K fertilizers level on bulb yield and its components for onion plants. Such data show that the application of 75% or 100% RFD resulted in the highest significant yield of onion bulbs and its components (BH, BD, NT, FW and TBY). The increment in total yield and its components due to the chemical fertilization may be refer to its positive effects on the activation of photosynthesis and metabolic processes of organic compounds in plants which in turn encourage bulbs growth (Abdissa *et al.,* 2011). In this respect, both Kandil *et al.,* (2013), and El Dardiry *et al.,* (2015) reported that the increase in bulb weight and bulb diameter due to the increase level of NPK could result of increasing the dry matter in plant foliage, which is diverted to bulb felling also enhancing the photosynthesis.

B-Effect of soil application with HAs and VAs

The application of K- humate (HAs) and/or Fulvate (VAs), individually or in combination, significantly increased bulb height (BH), bulb diameter (BD), neck thickness diameter (NTD), fresh weight of bulb /plant (BFW), and total bulb yield (TBY) when compared to control plants without K- humate or fulvate application (Table 7). It significantly surpassed all other treatments and exceeded control plant values by 15.69%, 17.93%%, 16.06%, 20.76%, and 17.67%, for BH, BD, NTD, BFW /plant, and TBY, respectively. The positive influence of K-humate on plant growth and yield could be due to the hormone-like activities present in HA that are involved indirectly in respiration, photosynthesis, oxidative phosphorylation, protein synthesis, anti-oxidant reactions, and various enzyme activities. The application of K- humate in combination with fulvate increased the uptake of nutrients significantly (Tables 5and 6), which ultimately increased chlorophyll levels and photosynthesis, resulting in elevated bulb height and bulb yield, as well as the fresh weight of bulb /plant (Nardi *et al.,* 2007; Ertani *et al.,* 2011; Parandian and Samavat, 2012).

Table 7. Effect of soil application of HAs and VAS, different rates of NPK fertilization and their interaction on yield and its components of onion plants (averaged over the two growing seasons).

Treatments		BH, cm	BD, cm	ND, cm	ABW, g	TBY, Ton fed^{-1}
NPK RFD levels						
50% RFD		4.90	5.41	1.32	85.33	17.60
75% RFD		4.96	5.50	1.37	91.26	18.29
100% RFD		5.06	5.64	1.41	98.17	19.64
L.S.D.at 5%		0.031	0.034	0.013	1.053	0.263
Application of organic polymers (HAs and VAs)						
Control		4.97	5.52	1.37	91.59	18.51
HAs		5.41	6.08	1.50	105.80	20.69
VAs		5.15	5.76	1.43	99.07	19.28
HAs+VAs		5.75	6.51	1.59	110.60	21.78
L.S.D.at 5%		0.026	0.063	0.034	1.370	0.325
Effect of the interaction						
	Control	4.9	5.41	1.32	85.33	17.60
50%	HAs	5.15	5.76	1.45	102.6	19.78
RFD	VAs	5.00	5.59	1.38	96.50	18.22
	HAs+VAs	5.49	6.25	1.56	108.2	20.82
	Control	4.96	5.50	1.37	91.26	18.29
75%	HAs	5.51	6.19	1.51	106.8	20.97
RFD	VAs	5.18	5.78	1.43	99.20	19.33
	HAs+VAs	5.84	6.59	1.59	110.9	21.98
	Control	5.06	5.64	1.41	98.17	19.64
100%	HAs	5.58	6.28	1.55	108.0	21.32
RFD	VAs	5.26	5.90	1.47	101.5	20.30
	HAs+VAs	5.91	6.68	1.61	112.7	22.54
L.S.D.at 5%		0.061	0.102	n.s.	1.580	n.s.

50%, 75% and 100% of Recommended NPK fertilizers does (RFD)
HAs and VAs astow organic polymers of K humate and falvate

C- Effect of the treatments interaction

In regard to the interaction between three levels of NPK (50, 75 and 100% of RFD) and some organic polymers (HAs and VAs) as soil drenched had a significant effect on yield and its components parameters of onion bulbs.

4-Bulbs quality:

a- Effect of mineral fertilizers application

Results in Table (8) show that the effect of N, P, and K fertilizers level on TC, %; TS, %; TSS, %,; DM, % and V.C, mg/100g in onion bulbs. Such data show that the application of 75% or 100% RFD resulted in the best bulb quality. The different rates of mineral fertilizers application led to significant increases in total carbohydrates %, Total Sugar %, TSS %, dry matter % and V.C mg/100g in onion bulb. Concerning the increment in bulb quality content due to NPK chemical fertilizers application might be owing to the vital role of these elements to enhance the photosynthetic activity, chlorophyll formation, accumulation of dry matter, N, P, K, total carbohydrates, Total Sugar content, and V.C (mg/100g) in these tissues (Abou El-Khair, 2004). These results are in agreement with those reported by El-Zohery (2003), Bardisi *et al.,* (2004 b) and El- Seifi *et al.,* (2004).

B-Effect of soil application with K- humate and fulvate

The data in Table (8) showed that HAs and/or VAs, individually or in combination, significantly increased TC%, TS %, T.S.S%, DM % and V.C, mg/100g when compared with the control treatment. The highest values of these parameters were obtained when onion plants received HAs+VAs produced the highest values of bulbs quality parameters followed by application with HAs then VAs while the control treatment gave the lowest values of these quality parameters. The application of humic acid (HAs) has indirect and direct beneficial effects; the indirect effects by improving soil aggregation, structure, fertility, and moisture-holding capacity, and increasing microbial activity (Sharif *et al.,*2002) microbial population, and cation exchange capacity.

The direct beneficial effects of HAs on plant growth and development where it affects cell membranes which lead to the enhanced transport of minerals, improved protein synthesis, promoted photosynthesis, modified enzyme activities, the solubility of micro and macro-elements, reduction of active levels of toxic minerals (Selim *et al.,* 2009). Fulvic acid (FA) is the second important humus substance, which is considered a good bio-stimulant for better plant growth and yield (Canellas *et al.,* 2015). Fulvic acid as an organic fertilizer is a non-toxic mineral chelating additive and water binder that maximizes uptake through leaves and stimulates plant productivity (Malan, 2015).

Table 8. Effect of soil application of HAs and VAS, different rates of NPK fertilization and their interaction on quality of onion bulbs (averaged over the two seasons).

Treatments		TC, %	TS, %	T.S.S, %	D.M, %	V.C,mg 100g^{-1}
NPK RFD levels						
50% RFD		15.25	6.88	13.08	16.52	12.13
75% RFD		15.43	7.09	13.14	16.86	12.23
100% RFD		15.63	7.18	13.34	17.18	12.33
L.S.D.at 5%		0.127	0.032	0.012	0.094	0.027
Application of organic polymers (HAs and VAs)						
Control		15.44	7.05	13.19	16.85	12.23
HAs		17.73	8.38	14.11	17.86	13.29
VAs		16.58	7.73	13.64	17.38	12.75
HAs+VAs		18.88	9.04	14.67	18.66	13.80
L.S.D.at 5%		0.053	0.049	0.020	0.049	0.027
Effect of the interaction						
	Control	15.25	6.88	13.08	16.52	12.13
50%	HAs	17.53	8.27	14.02	17.59	13.2
RFD	VAs	16.39	7.63	13.55	17.10	12.66
	HAs+VAs	18.70	8.93	14.51	18.33	13.71
	Control	15.43	7.09	13.14	16.86	12.23
75%	HAs	17.73	8.38	14.13	17.89	13.29
RFD	VAs	16.58	7.72	13.64	17.41	12.74
	HAs+VAs	18.91	9.06	14.72	18.72	13.8
	Control	15.63	7.18	13.34	17.18	12.33
100%	HAs	17.92	8.5	14.19	18.11	13.37
RFD	VAs	16.77	7.83	13.72	17.64	12.85
	HAs+VAs	19.03	9.14	14.79	18.94	13.88
L.S.D.at 5%		n.s.	n.s.	4.317	n.s.	n.s.

50%, 75% and 100% of Recommended NPK fertilizers does (RFD)
HAs and VAs astow organic polymers of K humate and falvate

C- Effect of the treatments interaction

Concerning the effect of NPK levels (50, 75 and 100% of RFD) and some organic acids polymers (HAs and VAs) on onion bulbs quality, data in Table (8) showed positive non-significant effects on TC%, TS%, DM and VC content. The best treatments were combination of 75 % or 100% RFD and HAs+VAs followed HAs then VAs respectively. Whereas TSS has significant positive response to the tested treatments.

CONCLUSIONS

Application of K- humate (HAs) and/or Fulvate (VAs), individually or in combination with onion plants induced positive effects on yield and nutrients uptake. In the presence of HAs and VAs, the optimum onion yield and its attributes can be obtained by applying only 75 or 100% of the recommended dose of chemical fertilizers (RFD) in comparison to the treatments received only mineral fertilizers. Plant uptake of N, P, and K substantially increased as well. In conclusion, application of K- humate and fulvate can lessen the need for chemical fertilizers by about 25% and subsequently reduced environmental pollution and cost of production.

REFERENCES

A.O.A.C. (Association of Official Analytical Chemist) (1990). "Official Method of Analysis". 15th ed. Association of Official Analytical Chemists, Washington. D. C., USA.

Abdissa Y., T. Tekalegn and L.M. Pant (2011). Growth, bulb yield and quality of onion (*Allium cepa* L.) as influenced by nitrogen and phosphorus fertilization on Vertisol I. growth attribute biomass production and bulb yield. Afr J Agric Res; 6(14): 3252-8.

Abou El-Khair, E. E. (2004).Effect of irrigation and fertilization treatments on garlic crop and its storage ability under sandy soil conditions. Ph.D. Thesis, PP 158, Faculty Agriculture, Zagazig University, Egypt.

Ali, A.H., M.M. Abdel-Mouty and A.M. Shaheen (2001). Effect of bio-nitrogen, organic and inorganic fertilizer, on the productivity of garlic (*Allium sativum*, L.) plants. Egypt. J. Appl. Sci., 16(3) 173-188.

Alkaff, H.A., O.S. Saeed and A.Z. Salm (2002). Effect of bio-fertilizer inorganic organic and foliar application of power 4 on the productivity of onion (Arabic). University of Aden Journal of Natural and Applied Sciences, University of Aden, Aden, Yemen, 6(1) 1-14

Al-Moshileh, A.M. (2001). Effect of nitrogen, phosphorus and potassium fertilizers on onion productivity in central region of Saudi Arabia. Assiut J. of Agric. Sci., 32 (1) 291-305.

Ameri A., and A. Tehranifar (2012). Effect of humic acid on nutrient uptake and physiological characteristic Fragaria x AnanassaVar: Camarosa. J Biol Env Sci 6:77–79

Anjum, S. A., L. Wang, M.Farooq, L.Xue and S.Ali (2011).Fulvic acid application improves the maize performance under well-watered and drought conditions. Journal of Agro. Crop Sci. 197 (6) 409- 417.

Bakry A.B., M.S. Sadak, H.T. Moamen and E.M. Abd El Lateef (2013). Influence of humic acid and organic fertilizer on growth, chemical constituents, yield and quality of two flax seed cultivars grown under newly reclaimed sandy soils. Int. J. Acad. Res. 5(5) 125–134.

Bardisi, A., A.A.EL- Mansi, A.N. Fayed and E.E. Abou El-Khair (2004 b). Effect of mineral NP and biofertilizers on garlic under sandy soil conditions. 2- Yield, bulb quality and storability. *Zagazig J. Agric. Res.*, 31 (4A): 1441- 1462.

Canellas, L.P., F.L Olivares, N.O. Aguiar, D.L. Jones, A. Nebbioso, P. Mazzei and. A.Piccolo, (2015). Humic and Fulvic Acids as Bio stimulants in Horticulture. Sci. Hortic., 196, 15–27.

Chapman, H.D. and P.F. Pratt (1961).“Methods of Analysis for Soil, Plant and Water”. California Univ., Div. Agric. Sci., Davis, California, U.S.A.

Cottenie, A., M. Verloo, L. Kiekens, G. Velghe and R.Camerlynck (1982). Chemical analysis of plant and soil. Laboratory of Analytical and Agrochemistry, State Univ., Ghent, Belgium, PP. 100 - 129

Delfine, S., R. Tognetti, E. Desiderio and A. Alvino (2005). Effect of foliar application of N and humic acids on growth and yield of durum wheat. Agron. Sustain. Dev. 25, 183-191.

Dubois, M.; K. A. Gilles; J. K. Hamilton; P. A. Robers and F. Smith (1956).Colorimetric method for determination of sugars and related substances. Annals Chem., 28: 350-356.

El- Seifi, S.K, Sowsan M.H. Sarg, A.I. Abd El- Fattah and M.A. Mohamed (2004).Effect of bio fertilizers and nitrogen levels on the productivity and quality of Chinese garlic under sandy soil conditions. *Zagazig J, Agric. Res.*, 31 (3): 889- 914.

El-Bassiouny H.S.M., A.B. Bakry, A.A. Abd El-Monem, and M.M. Abd Allah (2014). Physiological role of humic acid and nicotinamide on improving plant growth, yield, and mineral nutrient of wheat (*Triticum durum* L.) grown under newly reclaimed sandy soil. Agric. Sci. (5) 687–700.

Eldardiry, E.I., M. Abd El-Hady, M.S.A. Abou- El-Kheir, and A.A. Aboellil (2015). Effect of organic manure sources and NPK fertilizer on yield and water productivity of onion(*Allium cepa* L.)**.** *GARJAS*, 4(11)803-808.

EL-Desuki, M. and O.M.M. Sawan (2001). Effect of mineral fertilizers and sulphur application on growth, yield and quality of onion bulb. Annals of Agric. Sci., Moshtohor, (39) 617-628.

El-Desuki, M., (2004). Response of onion plants to humic acid and mineral fertilizers application. Annals of Agric. Sci., Moshtohor, (42) 1955-1964

El-Desuki, M., M.M. Abdel-Mouty and H.A. Aisha (2006). Response of onion plants to additional dose of potassium application. J. Appl. Sci. Res., 2(9): 592-597.

El-Zohery, S. S. M. (2003).Physiological studies on garlic crop. Ph.D. Thesis Zagazig University, Benha Branch, Faculty Agriculture, Moshtohor, pp160.

Ertani, A., O. Francioso, V. Tugnoli, V. Righi and S. Nardi, (2011). Effect of commercial lignosulfonate-humate on (*Zea mays* L.) metabolism. J. Agric. and Food Chemistry, (59) 11940-11948.

Eyheraguibel, B., J. Silvestre and P. Morard, (2008). Effects of humic substances derived from organic waste enhancement on the growth and mineral nutrition of maize. Bio resource Technology, (99) 4206-4212.

FAO, (2017). Food and Agriculture Organization of the United Nations, Rome, Italy. http:// www. fao.org /pulses-2016/international-year-of-pulses-seed-the-commons/en/

Gomez, K.A. and A.A. Gomez (1984). "Statistical Procedure for Agricultural, Research ", 2nd (Ed) John Wily and Sons, New York, USA.

Hu, J., J. Wu. A. Sharaf, J. Sun, and X. Qu, (2019).Effects of organic wastes on structural characterizations of fulvic acid in semiarid soil under plastic mulched drip irrigation. Chemosphere. 234: 830-836.

Kandil, A.A., A.E. Sharief and F.H. Fathalla, (2013). Effect of organic and mineral fertilizers on vegetative growth, bulb yield and quality of onion cultivars. ESci J. Crop Prod., 2(3) 91-100.

Khan, H., M. Iqbal, A. Ghaffoor and K. Waseem (2002). Effect of various plant spacing and different Nitrogen levels on the growth and yield of onion. Online, J. Biol. Sci., (2) 545–7.

Klute, A.A. (1986). 'Methods of Soil Analysis". American Society of Agronomy, Inc. Publishers, Madison, Wisconsin, U.S.A., 2nd Edition.

Kulikova, N.A., E.V. Stepanova and O.V. Koroleva (2005). Mitigating activity of humic substances: direct influence on biota. Use of humic substances to remediate polluted environments: from theory to practice. I.V. Perminova *et al*. (eds.).

Lotfi, R., M. Pessarakli, P. Gharavi-Kouchebagh and H. Khoshvaghti (2015) Physiological responses of Brassica napus to fulvic acid under water stress: Chlorophyll a fluorescence and antioxidant enzyme activity. The Crop Journal, (3) 434 - 439.

Mahmoud. A.R. and M.M. Hafez (2010). Increasing productivity of potato plants (*Solanum tuberosum*, L) by using potassium fertilizer and humic acid application. Inter. J. Acad. Res., 2 (2):83-88.

Malan, C., (2015). Review: humic and fulvic acids. A Practical Approach. In Sustainable soil management symposium. Stellenbosch, 5-6 November 2015, Agrilibrium Publisher.

Mayhew, L. (2004). Humic substances in biological agricultural systems. Acres, 34(1&2).

Mostafa, M. F. M., M. S. EL-Boray, T. El-Baz and Asmaa M. Omar (2017). Effect of Fulvic Acid and Some Nutrient Elements on King Ruby Grapevines Growth, Yield and Chemical Properties of Berries. J. Plant Production, Mansoura Univ., 8(2) 321-328.

Nardi, S., A. Muscolo, S. Vaccaro, S. Baiano, R.Spaccini, and A.Piccolo (2007). Relationship between molecular characteristics of soil humic fractions and glycolytic pathway and krebs cycle in maize seedlings. Soil Biology & Biochemistry, (39), 3138-3146

Nasreen, S., M.M. Haque, M.A. Hossian and A.T.M. Farid, (2007). Nutrient uptake and yield of onion as influenced by nitrogen and sulphur fertilization. Bangladesh J. Agric. Res., 32(3): 413-420.

Page, A. L., R. H. Miller and D. R. Keeny. (ed.) (1982). Methods of Soil Analysis, part2. Chemical and Microbiological Properties. Amer. Soc. of Agronomy. Madison, Wisconsin, USA.

Pant, H.K. and K.R. Reddy (2003). Potential internal loading of phosphorus in a wetlands constructed in agricultural land water research, Water Res., 37, pp.965–972.

Parandian, F. and S. Samavat (2012). Effects of fulvic and humic acid on anthocyanin, soluble sugar, α-amylase enzyme and some micronutrient elements in Lilium. International Res. J. App. and Basic Sciences, 3, 924-929.

Priya, B. N. V., K. Mahavishnan, D. S., Gurumurthy, H. Bindumadhava, A. P. Upadhyaya, and, N.K. Sharmaa (2014).Fulvic Acid (FA) for enhanced nutrient uptake and growth: Insights from biochemical and genomic studies. J. Crop Improvement, 28. (6) 740-757.

Rajpar, I., M. Bhatti, Z. Hassan, and A. Shah (2011). Humic acid improves growth, yield and oil content of (*Brassica compestris* L). Parkisan J. Agric. Engineering and Veterinary Sciences. 27 (2) 125-133.

Selim, E. M., A. A. Mosa and A. M. El-Ghamry (2009). Evaluation of humic substances fertigation through, surface and subsurface drip irrigation systems on potato grown under Egyptian sandy soil conditions. *Agr. Water Manag.* (**96)**, 1218–1222.

Shaheen, A.M., F. Rizk, A.M.M. El-Tanahy and E.H. Abd El-Samad (2011).Vegetative Growth and Chemical Parameters of Onion as Influenced by Potassium as Major and Stimufol as Minor Fertilizers. Vegetables Crop Research Dept., National Research Centre, Dokki, Cairo, Egypt. Australian J. Basic and App. Sci., 5(11) 518-525.

Sharif, M., R.A. Khattak, and M.S. Sarir (2002). Effect of different levels of lignitic coal derived humic acid on growth of maize plants. Communication in Soil Science and Plant Analysis 33:3567-3580.

Somogy, S. (1952). Notes of sugar determination. J. Biol. Chem. (195) 19-23.

Suganya, S.and R. Sivasamy (2006). Moisture retention and cation exchange capacity of sandy soil as influenced by soil additives. J Appl. Sci. Res. 2:949–951.

Taha, A. A., M. M. Omar and M.A. Ghazy (2016). Effect of humic and fulvic acids on growth and yield of lettuce plant. J. Soil Sci. and Agric. Eng., Mansoura Univ., 7(8) 517 – 522.

Witham, F.H., D. F. Blaydes and R.M .Dewlin (1971). Experiments in Plant Physiology. Von Nostrand Reinhold Company, New York, pp. 55-56.

إستجابة إنتاجية و جودة نباتات البصل لإثنين من البوليمرات العضوية تحت ظروف الإدارة المستدامة للتسميد المعدنى

هيام عبد الفتاح الشابورى و ماجدة على عويس
معهد بحوث الاراضى والمياه والبيئة – مركز البحوث الزراعية- جيزة – مصر

أجريت تجربتان حقليتان فى موسمين شتويين لعامي 2018/2017 و 2019/2018 فى مزرعة خاصة (طنبول الكبرى) السنبلاوين- محافظة الدقهلية – مصر بهدف دراسة تأثير هيومات و/ أو فلفات البوتاسيوم (اضافة أرضية) تحت معدلات مختلفة من الأسمدة المعدنية تمثل 50 ، 75 و 100% من المعدل السمادى الموصى بها والتداخلات بينهما على صفات النمو ومحتوى الأوراق من الكلوروفيل والعناصر المعدنية الكبرى و الصغرى بالاضافة إلى بعض المواد البيوكيميائية مثل الكربوهيدرات الكلية ، السكريات الذائبة والمواد الصلبة الذائبة الكلية وفيتامين(C) والمحصول و مكوناتة لصنف جيزة أحمر. ويمكن تلخيص أهم النتائج المتحصل عليها فيما يلى : -أشارت النتائج إلى أن زيادة التسميد المعدنى من 50 إلى 75 و100% أدى إلى زيادة معنوية فى جميع الصفات قيد الدراسة. - أظهرت النتائج أن هيومات وفلفات البوتاسيوم سببت زيادة معنوية فى إرتفاع النبات ، عدد الأوراق/ نبات ، قطر البصلة ووزنها ، نسبة المادة الجافة ، محتوى الكلوروفيل فى الأوراق ، الكربوهيدرات الكلية و محتوى الاوراق والأبصال من العناصر الكبرى و الصغرى. - أظهرت النتائج تفوق التطبيق المزدوج من (هيومات البوناسيوم + فلفات البوتاسيوم) على التطبيق المفرد بالنسبة لجميع الصفات تحت الدراسة. - أظهرت النتائج وجود تأثيرات معنوية للتداخل بين التسميد المعدنى والتطبيق المزدوج من (هيومات البوناسيوم + فلفات البوتاسيوم) على بعض الصفات المدروسة. - وقد أظهرت النتائج أن إستخدام التسميد المعدنى بمعدل 75% مع التطبيق المزدوج من (هيومات البوناسيوم + فلفات البوتاسيوم) كان أكثر المعاملات كفاءة فى التأثير على جميع الصفات حيث أنها تؤدى لخفض معدل إستخدام السماد المعدنى دون أن تؤدى لتقليل المحصول أوزيادة التلوث البيئى.