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The Role of Garlic and Onion Extracts in Growth and Productivity of Onion under Soil Application of Potassium Humate and Fulvate

Hayam A. El –Shaboury and Hanaa M. Sakara
Soil, Water and Environment Res. Inst., Agric. Res. Center, Giza, Egypt.

DURING winter seasons of 2017-2018 and 2018-2019, an experiment was conducted at a private farm located in El-Sarou, Damietta governorate, Egypt, to test the role of garlic and onion extract in foliar way on onion growth, yield, and quality as under soil addition of potassium humate and fulvate. In split plot design, the experimental was consisted of 3 replicate having 15 treatments arrangement as; 5 treatments of potassium humate and fulvate (control, 2 and 4 kg fed^{-1} for each form) as main plot, 3 levels of plant extract (without, 10 and 20 ml L^{-1} mix from garlic and onion extract) as sub plot. The obtained results indicated that, soil addition of 4 kg fed^{-1} potassium humate recorded the highest significant values for growth traits, yield and its components as well as N, P, K, Fe, Mn and Zn in leaves and bulb, also, recorded the highest significant in chemical and physical quality of bulb. Based, on the same parameters, increased with foliar application at the rate of 20 ml L^{-1} from plant extract. The combined application between 4 kg fed^{-1} potassium humate and foliar 20 ml L^{-1} plant extract was more prominent in enhancing the aforementioned traits. Addition of potassium humate 4 kg fed^{-1} increased available N, P, K $mg.kg^{-1}$ and porosity, while decreased EC $ds.m^{-1}$ in the soil after harvesting.

Key words: Potassium humate, Fulvate, Garlic and onion plant extract and Onion plant

Introduction

Allium crops and their relatives are recognized as a distinct family, the Alliaceae. Onion (Allium cepa L.) belongs to this family, which considered the most important crop grown in Egypt. The area harvested was about 63,723 (ha), while the national production was about 2304210 tons (FAO, 2018). The onion bulb contains vitamin C, protein, flavonoid and quercetin, which helps to eliminate free radicals in the human body, to inhibit low-density lipoprotein oxidation (an important reaction in atherosclerosis and coronary heart disease), to protect and regenerate vitamin E and to inactivate the harmful effects of chelate metal ions. Also, onion is a rich source of minerals like P and Ca (Fouda, 2016).

Plant bio stimulants based on humic substances are an alternative method for the improvement of crop production and soil fertility. Humic acids (HA) and Fulvic acids (FA) are natural bio-stimulants and which will improve the growth of plants. By the application of humic substance to plants, the growing plants are supplied with food, its application also results in productive and fertile soil, which increases the water-holding capacity of the soil (Suganya and Sivasamy, 2006). It plays a pivotal role in stimulates germination. The application of humic reduces the requirement of other fertilizers (Sani, 2014). It also increases crop yield, soil aeration, and drainage can also be improved by humic, the establishment of a desirable environment for the development of microorganisms. An increase in the protein and mineral contents of most crops is possible by the application of humic substances (Mosa et al. 2012). Mohan et al. (2020) studied the effect of humic and fulvic acid on yield and chemical quality in brinjal reported that the humic followed by fulvic acid application had increased the yield and chemical quality in brinjal.

*Corresponding author: E-mail: nemosema@gmail.com
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The world has become aware of the environmental problem in recent years. Synthetic compounds are highly polluting, hazardous and much more costly. Researchers are working in the field of natural products extensively as they are less hazardous, low cost and easily available (Phiri, 2010). Thus, there is a continuous need to search for alternative safe natural sources of plant nutrients, natural growth regulators even for protecting against disease (Prosecus, 2006). Public health and environmental safety encourage the use of plant extracts for improving growth, nutritional status, the productivity of crops and keeping quality (Mahmoud et al. 2018). Plant extracts are utilized to improve the production of many crops instead of using chemicals. The change for using plant extracts against chemicals was performed because pathogens resistance to the fungicides has developed as well as for protecting our environment from pollution. The higher own content of these plant extracts are plant pigments, phenolic compounds and essential oils which have a synergistic effect on the yield production of crops (Abdelaziz et al. 2020). The waste of peel and some of the flesh from onion and garlic of homes and factories could be used to prepare plant extract.

Onion and garlic are the most members known belonging to the allium family. Many of these biological effects are related to volatile sulphides such as allicin, alliin, ajoene, diallyl, allyl propyl, trisulfide, vinyl dithiines, S-allyl cysteine, S-allyl mercaptocystein and others, typical of the allium plants, which are also responsible for their characteristic pungent aroma and taste (Lanzotti, 2006). These compounds have an antioxidative, antibacterial, antiviral and antifungal effect its extract has a high nutritive value; it contains large number of important enzymes and more than 200 biochemical compounds such as antioxidants and vitamins (Fredotović and Puizina, 2019). It also, contains high contents of volatile and sulphur compounds (Mohamed and Akladious, 2014 and El-Saadony et al., 2017). Additionally, garlic is considered as a source of vitamins especially vitamin c and vitamin B complex, flavonoids, antioxidants, and minerals especially K, P and Se (Pekowska and Skupień, 2009), being even considered a rich source of other non-volatile phytonutrients with paramount medicinal and therapeutic properties, from which a particular emphasis is given to saponins , flavonoids and sapogenins, nitrogen oxides, phenolic compounds, proteins and amides (Lanzotti et al., 2014). Garlic or onion extracts significantly improved all plant growth characteristics of cucumber plant (Morsy et al. 2009). Abd El-Salam et al. (2014) resulted that onion water extracts caused the highest cumin total seed yield. Garlic water extracts resulted in the highest values of total carbohydrate, total protein and total free amino acids. It is hypothesized that peel extract from onion and garlic having a number of plant growth regulators, mineral nutrients and vitamins in a naturally balanced composition, may be beneficial for plant growth and development as indicated on onion, pea and potato plant (Shafeek et al. 2015; El-Saadony et al. 2017 and Dahshan et al. 2018).

To date, few studies have been focused on the effect of natural products extract and its significant in plant production. So, the objective of this study was to find out the influence of plant extract as garlic and onion with application of potassium humate or fulvate on productivity and quality bulb of onion plant.

Material and Methods

During winter seasons of 2017-2018 and 2018-2019, an experiment was conducted at a private farm located in El-Sarou, Damietta governorate, Egypt, to test the role of garlic and onion extract in foliar way on onion growth, yield, and quality as under soil addition of potassium humate and fulvate. In split plot design, the experimental was consisted of 3 replicate having 15 treatments arrangement as; 5 treatments of potassium humate and fulvate (control, 2 and 4 kg fed^{-1} for each form) as main plot, 3 levels of plant extract (without, 10 and 20 ml L^{-1} mix from garlic and onion extract) as sub plot.

The initial soil samples were collected from the experimental field to analyze the initial physico chemical properties. Mechanical analysis determined according to the methods of Haluschak, (2006) and texture of the soil was silty clay loam type. Content of nutrients in soil were; available N (41.1 $mg.kg^{-1}$), available P (4.96 $mg.kg^{-1}$), and available K (181.6 $mg.kg^{-1}$) with pH (7.96), EC (1.72 dSm^{-1}), OM (1.77 %), porosity 46.2 % and $CaCO_3$ (2.93 %) were determined according to (Reeuwijk, 2002), while micronutrients as; Fe (3.24 $mg.kg^{-1}$), Zn (0.72 $mg.kg^{-1}$) and Mn (1.52 $mg.kg^{-1}$) were analyzed by electrothermal atomic absorption spectrometery according to Kumpulainen et al. (1983).

The experimental unit area was 10.5 m^2 had five ridges (0.6 m in width and 3.5 m in length).

All agronomic practices were keeping normal and uniformed for all the treatments. Seedlings of the onion cv. Giza Red has transplanted in the mid of November for both seasons at distance of 10 cm apart between the plants on both sides of the ridges.

NPK fertilization was treated with 120 kg N.fed^{-1} of ammonium sulfate (20.5 % N) and 60 kg fed^{-1} potassium sulfate (48 % K_2O) were added in two equal doses where the first one after 15 days from planting and the second two weeks later, while super phosphate (15 % P_2O_5) at the rate of 45 kg fed^{-1} added in a full dose of P to the soil before planting.

Plant extracts

The peels with some parts of garlic and onion were washed with tap water and air-dried. The prepared air-dried materials were weighed (100 g) and soaked in 1 L water and stirred for 10 min every 12 hr for 72 hr. After 72 hr, the extract was filtered were diluted with tap water to get; 0, 10 and 20 ml L^{-1}, sprayed 3 times the 1st after 20 days from transplanting and every 20 days interval. Indole acetic acid, gibberellin and cytokinin were measured using spectrophotometers as described by (Assunção et al. 2009). While flavonoid and phenol as mentioned by (Ifesan, 2017). The chemical composition of the garlic and onion extract presented in Table 1.

Potassium humate and Potassium fulvate were applied to the soil at the rate of 2 and 4 kg fed^{-1} for each one with soil preparation.

At 85 days after transplanting 5 plants were randomly chosen for measuring the vegetative growth parameters such as plant height (cm), number of leaves, fresh and dry weight (g.plant^{-1}) as well as chlorophyll and carotenoid (mg.g^{-1} FW) were measured using spectrophotometric method of Gavrilenko and Zigalova (2003). The dried samples were stored for chemical analysis including N, P, K (%) and Fe, Zn and Mn (mg kg^{-1}).

Onion handily harvested at the mid of April and plants were collected in groups and dried for 10 days then onion yield components were taking place. The following parameters were recording such as bulb height and diameter (cm), neck thickness (cm), total yield (ton.fed^{-1}), Dry matter (DM%). Chemical constituents of bulbs expressed as N was obtained using the Kjeldahl method. P and K were measured using spectrophotometers and flame photometer, respectively as described by Rukun (1999), Fe, Zn and Mn were analyzed by electro thermal atomic absorption spectrometer according to Kumpulainen et al. (1983) then calculated as (kg fed^{-1}) for macronutrient and (g.kg^{-1}) for micronutrient. Quality parameters of fresh bulbs i.e., 1) Total carbohydrates determination in fresh tubers by the ethanol extract, total carbohydrates were estimated in hot acisic medium using antheron method and the green colors were measured spectrophotometrically at 630 nm. Sadasivam and Manickam, (1996). 2) Vitamin C was determined according to the method described by Mazumdar and Majumder (2003) using titrimetric estimation with 2, 6 dichloro phenol dye solution. 3) Total soluble solids (TSS %) were estimated using Galli 110 refractometer according to A.O.A.C.; (2000). as well as 4) Total soluble sugar, was determined according to the method described by Sadasivam and Manickam, (1996).

After harvesting, soil samples were taken from soil surface section (0-30) cm after cultivation for determination of available N, P and K (mg kg^{-1}) according to Reeuwijk (2002) and EC, bulk density and porosity according to Haluschak (2006).

Data for 2 years were combined for analysis. Significant differences among treatment means were determined at $P \leq 0.05$ by Duncan's Multiple Comparisons Test. Data of the present study were statistically analyzed using CoSTATE Computer Software, according to Gomez and Gomez (1984).

TABLE 1. Chemical composition of garlic and onion extracts

Indole acetic acid (mg L^{-1})	47.9
Gibberellin (mg L^{-1})	823.9
Cytokinin (mg L^{-1})	163.7
Flavonoid (mg g^{-1})	1.53
Phenols (mg g^{-1})	11.65

Results

Vegetative growth and pigment photosynthesis

The results obtained in Table 2 showed the significant effect of humic substances in form of potassium humate and fulvate on plant height cm, number of leaves/plant, fresh and dry weight g/plant and pigment photosynthesis (chlorophyll and carotenoid mg.g^{-1}) during both seasons. In this respect, the highest mean values recorded with the application of 4 (kg fed^{-1}) potassium humate comparing with other treatments and over the untreated plants.

Concerning the effect of the plant extract, the data in Table 2 revealed that, increasing the concentration of mix from organic and onion extract significantly increased vegetative growth and pigment photosynthesis. The same data indicated that the highest concentration 20 (ml L^{-1}) of garlic and onion extract caused the highest values of mentioned parameters during both seasons.

It is noticed from obtained data that vegetative growth and pigment photosynthesis of the onion plants was significantly affected by interaction treatments between humic substances and plant extract. With increasing concentration of garlic and onion extract with any application of potassium humate and fulvate, all previous traits were increased. The highest mean values of plant height (cm), number of leaves/plant, fresh and dry weight (g plant^{-1}) and pigment photosynthesis (total chlorophyll and carotenoid mg g^{-1} F.W) recorded with a foliar application (20 ml L^{-1}) from plant extract and (4 kg fed^{-1}) potassium humate during seasons of 2017-2018 and 2018-2019.

TABLE 2. Vegetative growth and pigment photosynthesis as affected by humic substance and plant extract (average of two growing seasons)

Treatments		Plant height (cm)	No. of leaves/ plant	Fresh weight (g plant^{-1})	Dry weight (g plant^{-1})	Total chlorophyll (mg.g^{-1} F.W)	Carotenoid (mg.g^{-1} F. W)
A: Humic substance (kg fed^{-1})							
Control		78.02e	7.34e	84.32e	8.28e	0.942e	0.789e
K-H 2		82.70c	8.24c	91.72c	9.48c	1.090c	0.891c
K-H 4		85.15a	8.86a	94.11a	10.57a	1.187a	0.949a
K-F 2		81.70d	8.02d	89.71d	9.21d	1.053d	0.867d
K-F 4		83.53b	8.60b	93.47b	10.05b	1.129b	0.920b
B: plant extract concentration (ml L^{-1})							
Without		79.72c	7.72c	86.97c	8.76c	1.003c	0.833c
GOE 10		83.13b	8.38b	92.22b	9.74b	1.107b	0.902b
GOE 20		83.82a	8.54a	92.82a	10.06a	1.132a	0.915a
C: Interaction effect							
	Without	76.45j	7.11l	83.23n	7.92m	0.901k	0.761i
Control	GOE 10	78.22i	7.40k	84.36m	8.34l	0.942j	0.796h
	GOE 20	79.40h	7.53jk	85.38l	8.57k	0.984i	0.811gh
	Without	79.75h	7.78hi	87.35j	8.90ij	1.017h	0.848f
K-H 2	GOE 10	83.91ef	8.41de	93.43e	9.60f	1.118d	0.899d
	GOE 20	84.44de	8.53d	94.39d	9.95e	1.135d	0.925c
	Without	82.92g	8.11fg	89.40h	9.24h	1.065f	0.875e
K-H 4	GOE 10	85.86bc	9.10b	97.49a	11.00b	1.227b	0.983a
	GOE 20	86.66a	9.38a	95.45c	11.47a	1.268a	0.988a
	Without	79.33h	7.67ij	86.35k	8.72jk	0.992i	0.828g
K-F 2	GOE 10	82.74g	8.21ef	90.43g	9.36gh	1.078ef	0.880de
	GOE 20	83.04fg	8.18f	92.33f	9.55fg	1.090e	0.894de
	Without	80.16h	7.93gh	88.51i	9.01i	1.039g	0.853f
K-F 4	GOE 10	84.90cd	8.80c	95.37c	10.38d	1.168c	0.950b
	GOE 20	85.54bc	9.07b	96.53b	10.75c	1.181c	0.957b

K-H: potassium Humate K-F: potassium Fulvate GOE: garlic and onion extract

Yield and its components

Data in Table 3 showed that soil application of humic substances (potassium humate and fulvate at different rates) were significantly effective in improving bulb height (cm), diameter (cm), neck thickness (cm), total yield (ton.fed^{-1}) and Dry matter (%). With an increasing rate of humic substances found an increase in yield and physical quality of bulb comparing with the untreated plants during both seasons of the experiments. The highest mean values of bulb height, diameter cm, neck thickness cm, total yield (ton.fed^{-1}) and dry matter (%) recorded with soil application (4 kg fed^{-1}) potassium humate.

Results recorded in Table 3 indicated that foliar application with plant extracts from garlic and onion with different concentrations (0, 10 and 20 ml L^{-1}) significantly increased yield and physical quality of bulb. Also, data revealed that the highest values of the investigated yield and its components were, generally, recorded with foliar application of plant extracts from garlic and onion at the rate of (20 ml.l^{-1}) and realized high values of (5.65, 6.35, 1.54, 21.88 and 16.31) for bulb height (cm), diameter (cm), neck thickness (cm), total yield (ton.fed^{-1}) and dry matter (%), respectively.

Data concerned with the interaction effect of humic substances (potassium humate and fulvate at different rates) and foliar application of plant extract at different levels on yield measurements expressed as bulb height (cm), diameter (cm), neck thickness (cm), total yield (ton fed^{-1}) and dry matter (%) during both seasons were presented in Table 3. The obtained results indicated a significant positive effect of all of (2 and 4 kg fed^{-1}) for each potassium humate and fulvate and (10 and 20 ml L^{-1}) plant extract comparing with the untreated plants on the investigated characters and the highest values were obtained with potassium humate with any concentration of plant extract. Data showed that humic acid (4 kg fed^{-1}) with a foliar application (20 ml L^{-1}) garlic and onion extract gave the highest values in two seasons of the experiments.

TABLE 3. Yield measurements as affected by humic substance and plant extract (average of two growing seasons)

Treatments		Bulb height (cm)	Bulb diameter (cm)	Neck thickness (cm)	Total yield (ton.fed^{-1})	Dry matter (%)
A: Humic substance (kg fed^{-1})						
Control		5.09e	5.69e	1.38e	19.84e	13.65e
K-H 2		5.49c	6.19c	1.51c	21.51c	15.83c
K-H 4		5.84a	6.67a	1.59a	22.35a	16.87a
K-F 2		5.35d	6.05d	1.48d	21.15d	15.27d
K-F 4		5.65b	6.36b	1.54b	21.79b	16.34b
B: plant extract concentration (ml L^{-1})						
Without		5.26b	5.95b	1.43b	20.56c	14.55c
GOE 10		5.56a	6.28a	1.52a	21.55b	15.92b
GOE 20		5.65a	6.35a	1.54a	21.88a	16.31a
C: Interaction effect						
	Without	4.99i	5.60k	1.35l	19.43kf	13.24o
Control	**GOE 10**	5.08hi	5.68jk	1.38kl	19.82j	13.59n
	GOE 20	5.19h	5.79ij	1.40jk	20.26i	14.12m
	Without	5.32g	5.90hi	1.44hi	20.84h	14.73k
K-H 2	**GOE 10**	5.50e	6.32def	1.54de	21.70e	16.22f
	GOE 20	5.64d	6.36de	1.56cd	22.00d	16.54e
	Without	5.39fg	6.42cd	1.48fg	21.11g	15.33i
K-H 4	**GOE 10**	6.00b	6.76ab	1.63ab	22.77b	17.44b
	GOE 20	6.12a	6.84a	1.65a	23.17a	17.86a
	Without	5.17h	5.81ij	1.42ij	20.41i	14.43l
K-F 2	**GOE 10**	5.41efg	6.16fg	1.50ef	21.38f	15.53h
	GOE 20	5.48ef	6.20ef	1.52e	21.66e	15.85g
	Without	5.36g	6.00gh	1.46gh	20.99gh	15.03j
K-F 4	**GOE 10**	5.79c	6.49cd	1.58c	22.06d	16.83d
	GOE 20	5.82c	6.58bc	1.60bc	22.30c	17.17c

K-H: potassium Humate K-F: potassium Fulvate GOE: garlic and onion extract

Nutrition values in leaves and bulbs

The soil application potassium humate or fulvate at different rates comparing with the untreated plants significantly effect on nutrition values in leaves and bulbs (N, P, K, Fe, Zn and Mn) as indicated in Tables 4 and 5. The highest values of macronutrient (N, P and K) and micronutrient (Fe, Zn and Mn) in leaves and bulbs were obtained with application (4 kg fed^{-1}) potassium humic followed by 4 kg fed^{-1} potassium fulvate all over the control during both seasons. Treatments could be arranged in the following order regarding the effects (4 kg fed^{-1}) potassium humic > (4 kg $fed^{-1)}$ potassium fulvate > (2 kg fed^{-1}) potassium humate > (2 kg fed^{-1}) potassium fulvate.

The nutrition values of onion leaves and bulbs as affected by different treatments from foliar application of plant extract under investigation recorded at Tables 4 and 5. The statistical analysis of the obtained data showed that the differences within the addition of different treatments addition were true to reach the significant level in the average two experiments except Fe in the leaves had no significant effect between (10 ml L^{-1}) and control. Macro and micronutrient content of onion leaves and bulbs tissues increased with plants received (10 and 20 ml L^{-1}) plant extract over control. Generally, recorded their peaks with that plants received (20 ml L^{-1}) garlic and onion extract.

It could be summarized that, the interaction effect between soil addition of humic substances and different concentration of plant extract revealed in Tables 4 and 5 that all foliar application under any rates of humic substances for both forms significantly increased nutrition values in leaves and bulbs. Among the following treatments, the treatment (4 kg fed^{-1} potassium humate and foliar application of 20 ml L^{-1} plant extract) exhibited the better results in terms of N, P, K, Fe, Zn and Mn in leaves and bulbs.

TABLE 4. Nutrition values in leaves as affected by humic substance and plant extract (average of two growing seasons)

Treatments		Macronutrients			Micronutrients		
		N (%)	P (%)	K (%)	Fe (mg.kg^{-1})	Zn (mg.kg^{-1})	Mn (mg.kg^{-1})
A: Humic substance (kg fed^{-1})							
Control		2.93e	0.261e	2.40e	42.32e	28.78e	17.02e
K-H 2		3.42c	0.297c	2.76c	44.17c	30.82c	18.14c
K-H 4		3.71a	0.322a	3.05a	45.08a	31.80a	18.92a
K-F 2		3.28d	0.287d	2.68d	43.78d	30.32d	17.97d
K-F 4		3.59b	0.310b	2.89b	44.63b	31.31b	18.49b
B: plant extract concentration (ml L^{-1})							
Without		3.12c	0.276c	2.56c	43.08b	29.61c	17.63c
GOE 10		3.47b	0.302b	2.82b	44.34ab	30.94b	18.22b
GOE 20		3.57a	0.309a	2.89a	44.57a	31.27a	18.48a
C: Interaction effect							
	Without	2.74k	0.251l	2.30k	42.01k	28.50o	16.65l
Control	GOE 10	2.97j	0.262k	2.41j	42.37jk	28.77n	17.02k
	GOE 20	3.09i	0.271j	2.49i	42.58ij	29.09m	17.38j
	Without	3.20h	0.280hi	2.59h	43.17h	29.72k	17.82hi
K-H 2	GOE 10	3.46e	0.300e	2.80e	44.55de	31.18f	18.12f
	GOE 20	3.61d	0.311d	2.91d	44.79cd	31.55e	18.48e
	Without	3.30g	0.289g	2.72fg	43.81fg	30.27i	18.01fg
K-H 4	GOE 10	3.86b	0.335b	3.15b	45.58ab	32.41b	19.20b
	GOE 20	3.98a	0.342a	3.29a	45.86a	32.72a	19.55a
	Without	3.10i	0.275ij	2.54hi	42.96hi	29.49l	17.75i
K-F 2	GOE 10	3.35fg	0.292fg	2.77ef	44.09ef	30.56h	18.05f
	GOE 20	3.40ef	0.296ef	2.75ef	44.28def	30.91g	18.10f
	Without	3.28gh	0.286gh	2.66g	43.43gh	30.06j	17.90gh
K-F 4	GOE 10	3.72c	0.320c	2.98cd	45.12bc	31.81d	18.70d
	GOE 20	3.77c	0.324c	3.04c	45.34ab	32.07c	18.88c

K-H: potassium Humate K-F: potassium Fulvate GOE: garlic and onion extract

TABLE 5. Nutrition values in bulbs as affected by humic substance and plant extract (average of two growing seasons)

Treatments		Macronutrients			Micronutrients		
		N (kg fed^{-1})	P (kg fed^{-1})	K (kg fed^{-1})	Fe (g.fed^{-1})	Zn (g.fed^{-1})	Mn (g.fed^{-1})
A: Humic substance (kg fed^{-1})							
Control		44.52e	4.28e	38.07e	38.79e	11.46e	9.25e
K-H 2		65.97c	6.25c	58.13c	52.88c	18.30c	15.87c
K-H 4		79.54a	7.63a	69.75a	60.62a	22.12a	19.50a
K-F 2		60.10d	5.65d	51.85d	48.88d	16.45d	13.80d
K-F 4		71.80b	6.86b	63.27b	55.70b	19.73b	17.57b
B: plant extract concentration (ml L^{-1})							
Without		52.82c	5.02c	45.31c	44.28c	13.97c	11.58c
GOE 10		68.00b	6.47b	59.65b	53.46b	18.57b	16.35b
GOE 20		72.34a	6.91a	63.68a	56.39a	20.30a	17.66a
C: Interaction effect							
	Without	40.57o	3.86o	35.00o	35.97n	10.46n	8.31o
Control	GOE 10	44.45n	4.27n	37.71n	38.52m	11.34m	9.40n
	GOE 20	48.54m	4.71m	41.49m	41.88l	12.58l	10.04m
	Without	54.84k	5.21k	46.03k	45.82j	14.44j	12.15k
K-H 2	GOE 10	68.50f	6.51f	62.52f	54.98e	19.34e	16.97f
	GOE 20	74.58e	7.05e	65.85e	57.85d	21.13d	18.49e
	Without	60.19i	5.66i	51.88i	48.85h	16.06h	13.60i
K-H 4	GOE 10	86.55b	8.34b	75.83b	64.66b	23.87b	21.68b
	GOE 20	91.87a	8.89a	81.54a	68.36a	26.42a	23.21a
	Without	51.53l	4.95l	43.29l	43.47k	13.47k	10.87l
K-F 2	GOE 10	62.86h	5.84h	54.35h	50.48g	17.15g	14.44h
	GOE 20	65.91g	6.15g	57.90g	52.70f	18.74f	16.09g
	Without	57.00j	5.45j	50.36j	47.28i	15.42i	12.96j
K-F 4	GOE 10	77.62d	7.39d	67.84d	58.67d	21.13d	19.26d
	GOE 20	80.79c	7.75c	71.60c	61.16c	22.65c	20.48c

K-H: potassium Humate K-F: potassium Fulvate GOE: garlic and onion extract

Chemical quality of bulbs

The different comparisons tabulated in Fig. 1 - 4 indicated that adding more rate of 2 to 4 (kg fed^{-1}) from both potassium humate and fulvate significantly increased the chemical quality of bulbs as total carbohydrates, total sugar, TSS and VC. The highest mean values for the above-mentioned traits were found to be associated with the addition of 4 (kg fed^{-1}), potassium humate comparing to the other treatments. In the same Figures found that foliar application with different concentrations of plant extract significantly increased all mentioned parameters and the highest values recorded with the plants received 20 (mg L^{-1}). In this respect, the suitable treatment which realized the good chemical quality of bulbs was (soil addition of 4 kg fed^{-1} potassium humate and foliar application 20 mg L^{-1} garlic and onion extract).

Soil analysis

The soil addition of potassium humate or fulvate at different rates are presented in Table 6, revealed that with increasing rates addition of potassium humate or fulvate found a significant increase in available N, P, K (mg.kg^{-1}) and porosity%, while the same addition reduced EC (ds.m^{-1}). The highest values of N, P, K (mg.kg^{-1}) and porosity (%) were recorded with the addition of (4 kg fed^{-1}) potassium humate, while the same rate recorded the lowest value of EC (ds.m^{-1}).

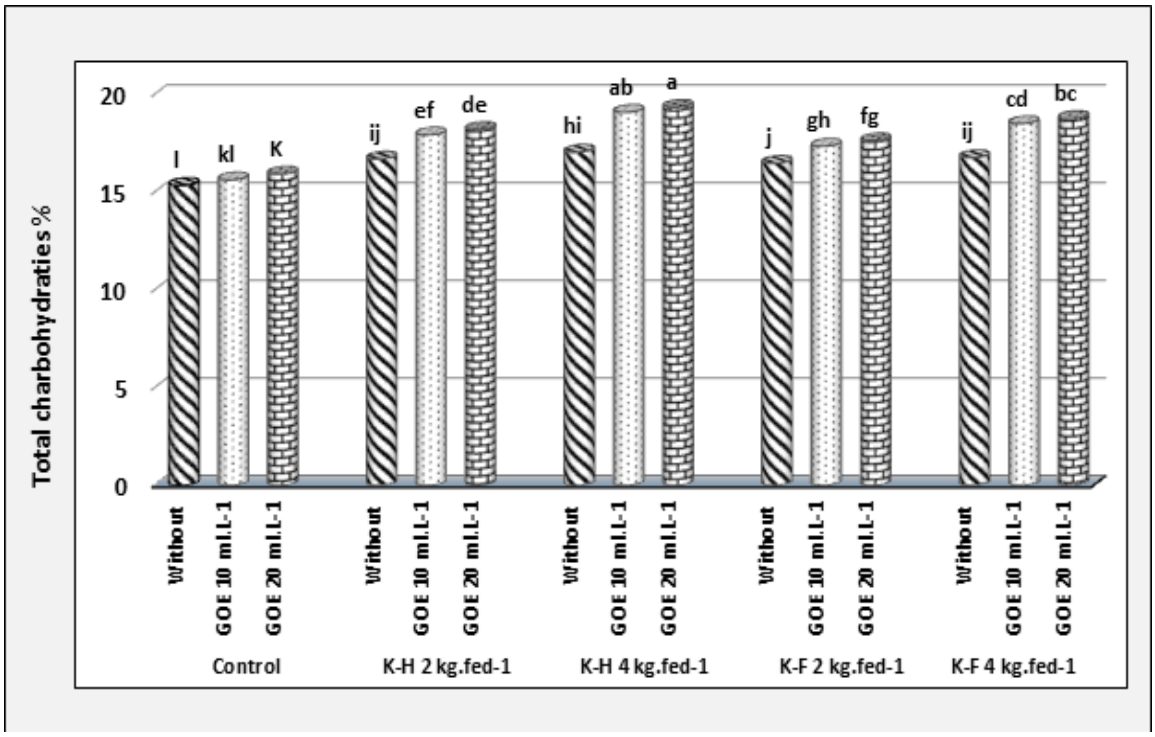

Fig. 1. Total carbohydraties % as affected by garlic and onion extract under potassiume humate and fulvate (average of two growing seasons)

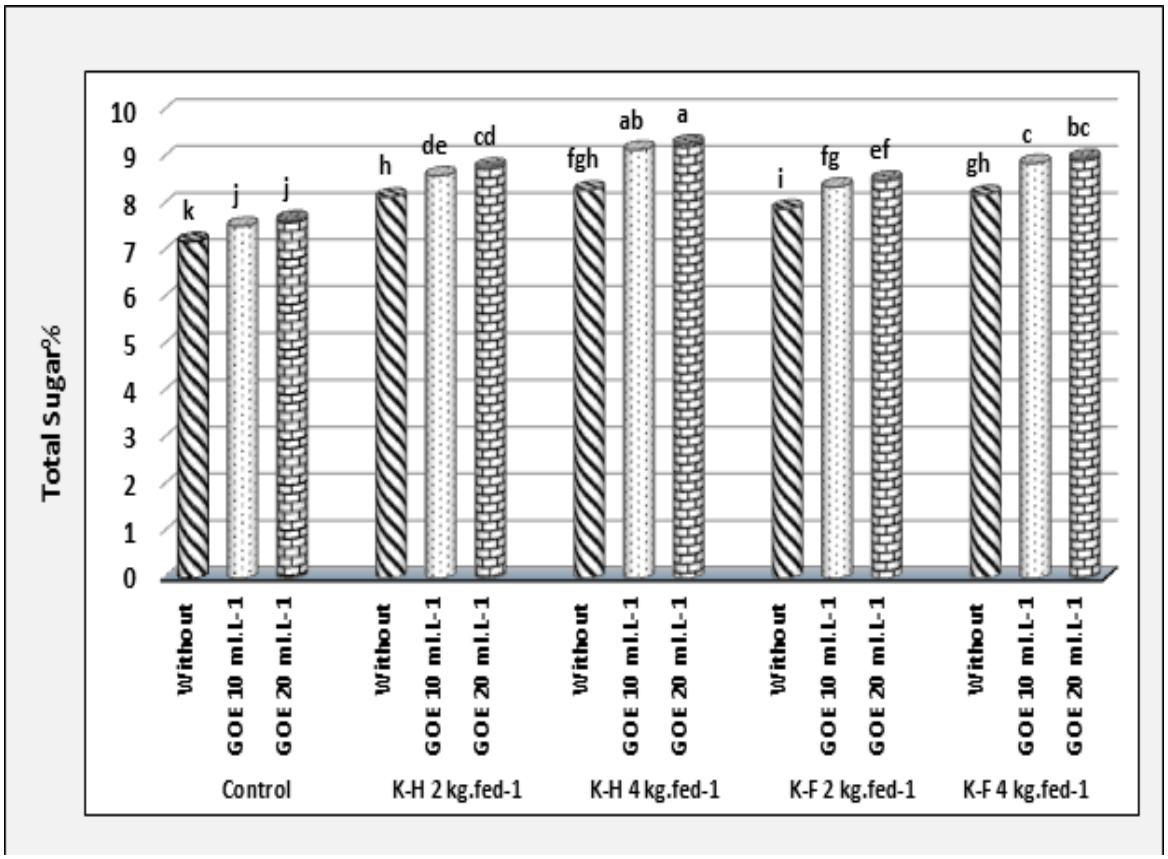

Fig. 2. Total sugar% as affected by as affected by garlic and onion extract under potassiume humate and fulvate (average of two growing seasons)

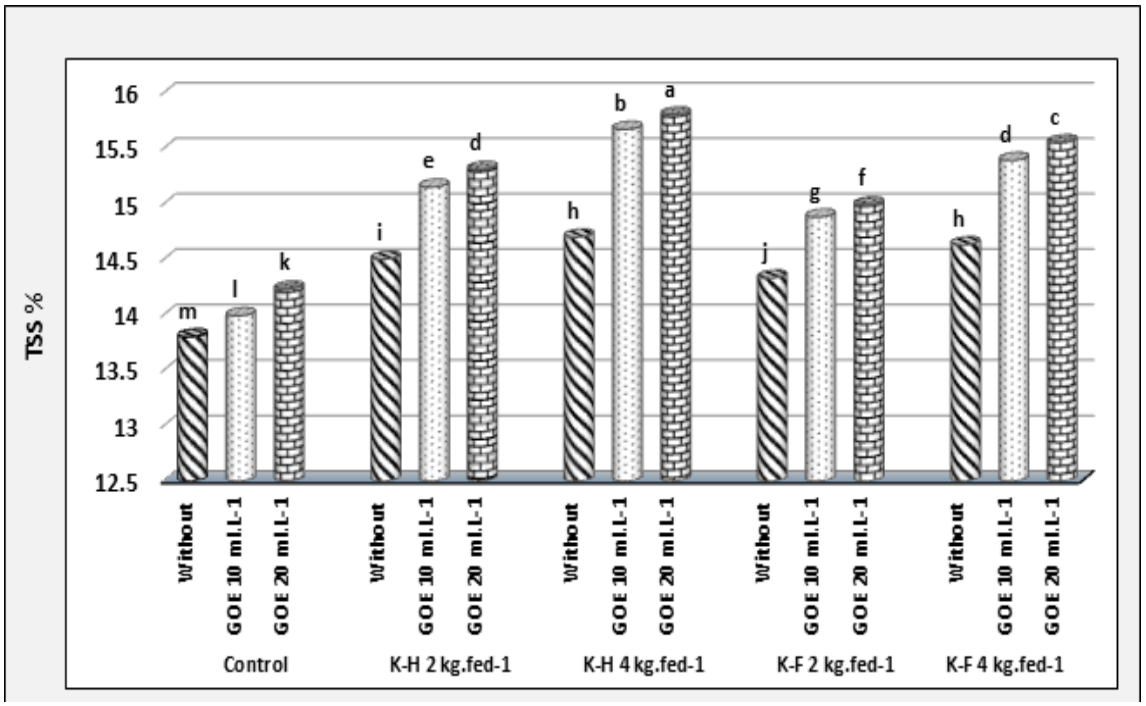

Fig. 3. TSS% as affected by by garlic and onion extract under potassiume humate and fulvate (average of two growing seasons)

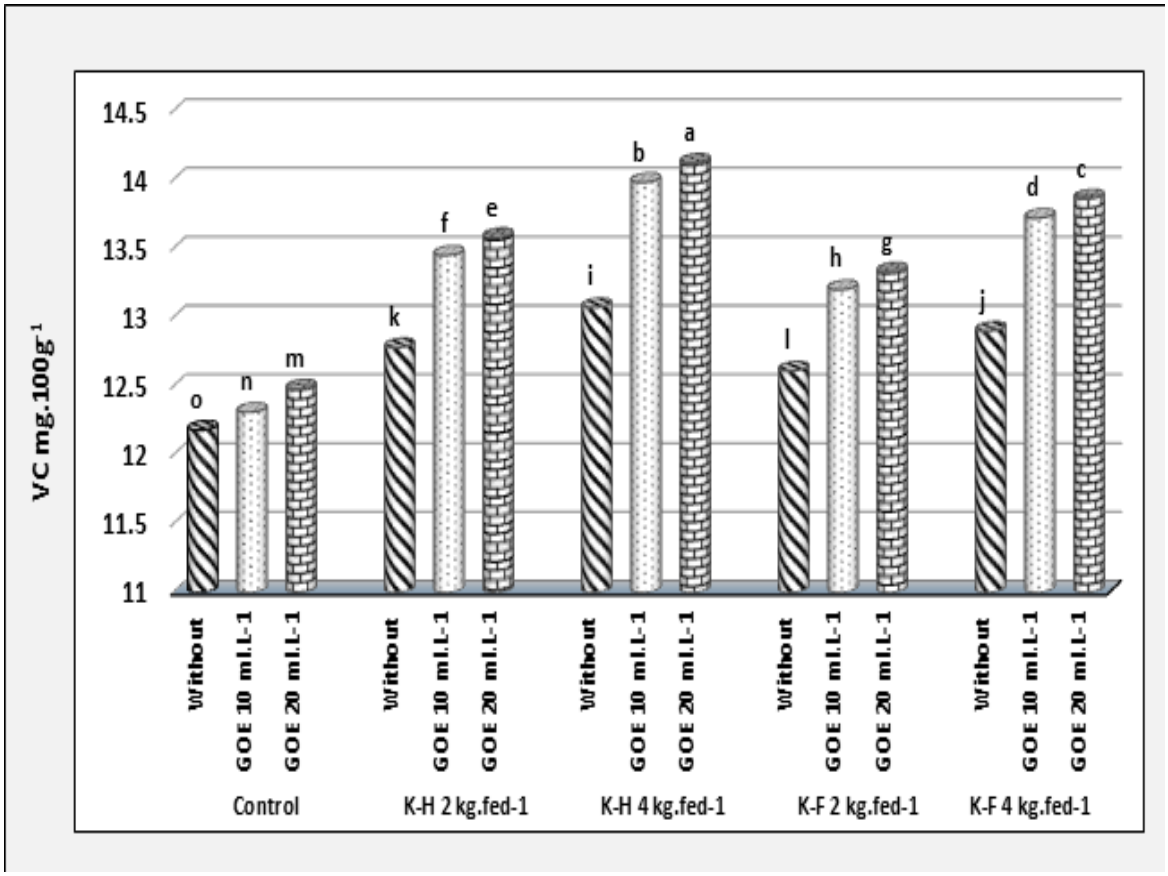

Fig. 4. VC mg.100g^{-1} as affected by by garlic and onion extract under potassiume humate and fulvate (average of two growing seasons)

TABLE 6. Soil analysis after harvesting as affected by humic substance and plant extract (average of two growing seasons)

Treatments		N- (mg.kg^{-1})	P- (mg.kg^{-1})	K-(mg.kg^{-1})	EC (ds.m^{-1})	Porosity (%)
Control	Without	50.49m	5.95m	215.41m	1.68ab	47.1f
	GOE 10	46.30n	5.68n	204.95n	1.71a	47.2ef
	GOE 20	43.31o	5.03o	193.52o	1.65b	47.4ef
K-H 2	Without	66.59g	7.33g	270.74g	1.46cd	48.3cd
	GOE 10	61.79i	6.95i	252.90	1.43de	48.6c
	GOE 20	56.66k	6.47k	234.33k	1.39e	48.8c
K-H 4	Without	81.3a	9.21a	324.13a	1.26hi	52.1a
	GOE 10	76.44c	8.54c	306.22c	1.32f	52.3a
	GOE 20	71.46e	7.83e	288.34e	1.22i	52.6a
K-F 2	Without	64.28h	7.15h	261.69h	1.48c	47.5ef
	GOE 10	59.26j	6.72j	243.44j	1.50c	47.7def
	GOE 20	53.91l	6.18l	225.87l	1.46cd	47.8de
K-F 4	Without	78.90b	8.89b	314.90b	1.34f	49.9b
	GOE 10	73.88d	8.16d	296.76d	1.31fg	50.2b
	GOE 20	68.91f	7.55f	279.23f	1.27gh	50.4b

K-H: potassium Humate K-F: potassium Fulvate GOE: garlic and onion extract

Discussion

Soil application of humic substances significantly increased all traits under investigation. In this regard, the pronounced increases in vegetative growth parameters as (plant height, number of leaves, fresh and dry weight) was observed with the application of 4 kg fed^{-1} potassium humate. It converted into readily available humic substances which directly or indirectly improved the soil fertility and increasing the availability of nutrient elements and consequently increased plant growth, which related to the positive role of humic acid influence on physiological processes (cell respiration, photosynthesis, protein synthesis, water and nutrient uptake and enzymatic activity) (Traversa et al. 2013). Such results were reported by many investigators such as Abou El Hassan and Husein (2016); Doklega, (2017); Hamad and Tantawy (2018).

Humic acid substances are usually applied to the soil, and favorably affect the soil structure and soil microbial population and hence make available the essential nutrients for the better growth of the plant, which in turn increased bulb quality and total yield of onion plant. In addition, the effect of humic acid on chemical composition of onion and bulb chemical quality may be attributed to the favorable effect of humic acid that led to effects cell membranes, leading to enhanced transport of minerals, improved protein synthesis, plant hormone-like activity, promoted photosynthesis, modified enzyme activities, solubilization of micro and macro elements, reduction of active levels of toxic minerals, and increased microbial populations (Malan, 2015). Also, Hartz and Bottoms (2010) concluded that the combined capacity of humic acids both to chelate nutrients enhancing the micro nutrient availability such as Fe and move through membranes has suggested the humic acids may play similar roles as natural chelates in the mobilization and transport of Fe and other micronutrients. Our results are in line with the study of Mahmoud et al. (2019), Mohamed, (2020) and El –Shaboury and Ewais, (2020). As for the effect of soil addition of potassium humate and fulvate on soil, the analysis found that humic substances increased available nutrients. Humic acids and their derivatives improved phosphorus availability due to their beneficial effect on binding active Ca^{2+} ions (El-Ghamry et al., 2009). The availability of nutrients also may be due to the improving in soil nutrients retention and enhancing soil microbial activity, which works to convert the organic form of nutrients to mineral

form (Stevenson, 1994). Similar observations were also obtained by (Mahmoud et al. 2011 and Mosa et al. 2020).

Data presented above showed the promotive effect of different concentrations (a mixture of garlic and onion extract) on growth parameters, total yield and physical quality of onion bulb. The results also indicated an increase in photosynthetic pigment contents and nutrition values of macro and micro elements as well as onion bulb quality. This growth improvement in onion plant can be established by the fact that garlic is rich in antioxidant phytochemicals that include organo sulfur compounds as well as flavonoids such as allicin, which is capable of scavenging free radicals (Nishion, 1990) and Goldan et al. (1988) mentioned that, volatile sulfur compounds in onion such as carbon disulfide (CS_2), carbonyl sulfide (COS), hydrogen sulfide (H_2S), methylmercaptan (CH_3SH), and sulfur dioxide (SO_2) can be taken up by all onion parts. However, progress has been made in elucidating the implied routes in the regulation of sulphur in relation to the vegetative growth of plants (Hawkesford and De Kok, 2006). In the process of assimilation of sulphur by the plant, inorganic sulphur is fixed as cysteine after a process of reduction. Cysteine is the initial material for the production of reduced glutathione, which is responsible for detoxing cells through the elimination of free radicals and reactive species that accumulate during different types of stress. The sulphur molecules derived from extract garlic and onion can be assimilated by the plant in the latent stage, it can favor the detoxification of the plant and promote bud breaking (El-Shayeb, 2009).

This increase might be due to the content of mixture aqueous extract of garlic and onion, which is rich in nutrients such as Na, K, Zn, P, Mn, Mg, Ca, and Fe as well as enzymes, vitamins B and C. Therefore, it offers a balanced source of nutrition for onion growth. The availability of these nutrients for the plant in sufficient qualities was necessary for its growth and precisely concerning to their role in increasing the division and extending the cells, beside to improving the performance of plant growth regulators, which are interfere in the extending and elongation of the cells, or it might be due to the existence of auxin–like materials within the garlic extract, so when the extract applied, especially of high concentration to the plants, the plant hormones content (auxin) will increase in the plant, causing an increase in vegetative growth characteristics, which one of them was increasing plant height, leaf number, fresh and dry weight reflected on increasing fruit number/plant (El-Hamied and El-Amary 2015; Al Mayahi and Fayadh, 2015). Foliar application of garlic and onion extract accelerates plant growth by stimulating the production of photosynthetic pigments and soluble sugars (Mohamed and Akladious 2014). Similar results were obtained by Abd Abdel-Moneim et al. 2015; Shafeek et al., 2015; El-Saadony et al. 2017; Dahshan et al. 2018.

Conclusion

Results of this study are very promising as most of the used treatments whether humic substances or plant extract enhanced onion plants to produce bulbs with good qualities and suitable for marketing medium. The used substances especially with the foliar application treatment also increased bulbs content of macro and micro nutrient as well as chemical quality of bulbs within the acceptable ranges for good feeding. From these results, we are encouraged to ask onion farmers to use natural extracts as mixture of garlic and onion at the rate of 20 ml L^{-1} in producing onion under application of potassium humate at rate of 4 kg fed^{-1}.

Conflict of interest

- There is no conflict between authors.

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دور مستخلص الثوم و البصل على النمو و الانتاجيه لنبات البصل المزروع تحت تأثير الإضافات الأرضيه من هيومات و فلفات البوتاسيوم

هيام عبد الفتاح الشابورى و هناء محمد صقاره
معهد بحوث الأراضي والمياه والبيئة مركز البحوث الزراعية – الجيزة

خلال الموسمين الشتويين لسنه ٢٠١٧-٢٠١٨ و٢٠١٨-٢٠١٩ أجريت تجربتان حقليتان في مزرعة خاصه بمنطقه السرو، محافظه دمياط، مصر لاختبار الدور الذى يقوم به مستخلص الثوم و البصل على النمو والمحصول والإنتاجية لنبات البصل تحت تأثير الإضافات الأرضية من هيومات و فلفات البوتاسيوم. صممت التجربة في قطاعات منشقه لثلاث مكررات تحتوى على ١٥ معامله عباره عن ٥ معاملات من أسمده الهيوميك (كنترول، ٢، ٤ كجم.فدان$^{-1}$ لكل من هيومات و فلفات البوتاسيوم) كقطع رئيسيه، ٣ مستويات من مستخلص الثوم و البصل (عدم إضافة، ١٠، ٢٠ مل.لتر$^{-1}$) كقطع منشقه. أشارت النتائج تحت الدراسة الى أن إضافة ٤ كجم.فدان $^{-1}$ من هيومات البوتاسيوم أدى الى زياده معنويه في صفات النمو و المحصول بالإضافة لمحتوى الأوراق و البصله من عناصر النيتروجين، فوسفور، بوتاسيوم، حديد، منجنيز، زنك، كذلك صفات البصلة الفيزيائيه و صفات الجوده. نفس الصفات السابقه زادت عند الرش بمعدل ٢٠ مل.لتر$^{-1}$ من مستخلص الثوم والبصل. أما بالنسبه للتفاعل المشترك بين المعاملات أوضحت أن اضافه ٤ كجم.فدان$^{-1}$ هيومات بوتاسيوم مع الرش بمعدل ٢٠ مل.لتر$^{-1}$ مستخلص ثوم و بصل سجلت أعلى القيم لجميع الصفات تحت الدراسه. الإضافه الارضيه بمعدل ٤ كجم.فدان$^{-1}$ من هيومات البوتاسيوم أدت الى تسجيل اعلى صلاحيه و تيسير للعناصر في التربه بعد الحصاد كذلك المساميه الكليه و لكنها أدت الى انخفاض في محتوى الأملاح في التربة.