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MITIGATE SALINE STRESS BY USING UNTRADITIONAL MATERIALS AND ITS EFFECT ON VEGETATIVE GROWTH OF GARLIC PLANTS GROWN IN SANDY SOILS

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Key Words: untraditional nanomaterials, garlic plants, vegetative growth, salt stress and sandy soils.

ABCTRACT

The experiment was conducted on pots filled with sandy soil affected by salts, the soil concentration of salts was 8.15 dSm^{-1} and the EC of irrigation water was 7.02 dSm^{-1}. The experiment was conducted in the Agricultural Research Center in Giza, Egypt. Garlic (*Allium sativum* L., var. sids 41) was grown during winter seasons of 2019-2020 and 2020-2021. The untraditional materials as pomegranate peels, diatoms powder, banana peels and orange peels were grinded with a kitchen mill and investigated by Transmission Electron Microscope (TEM). Thirteen treatments from pomegranate peels, diatoms powder, banana peels and orange peels at nanoscale in three doses of 0.15, 0.3 and 0.6(g) and control treatment were applied. The research was amid to study the effect of some untraditional materials at the nanoscale to mitigate salt stress on garlic plants at vegetative growth stage grown in sandy soils. The data showed that addition of diatoms nanopowder with dose of 0.6(g pot^{-1}) was the superior treatment for mitigating salt stress on garlic plants at vegetative growth stage under salt stress grown in sandy soils compared to other materials at different doses used and control treatment.

INTRODUCTION

Garlic (*Allium sativum* L.) is an important vegetable crop. It has been used since ancient times for medicinal and culinary purposes all over the world. In Egypt, garlic is considered the second cultivated bulb crop after onion and it is an important source of foreign exportation.

Salinity is one of the most important environmental determinants of plant growth and productivity. Generally, about third of the cultivated soils is considered to be affected by salinity **(Kaya *et al.,* 2002).** It is known that high salinity in the soil adversely affects plant growth, as the high osmotic pressure around the plant due to roots uptake inhibition for water and nutrients. Also, a nutritional imbalance may occur in the ground solution that leads to precipitation of some nutrients, competitive absorption or direct toxicity due to excess salinity **(Greenway and Munns, 1980)**. In salty environments, sodium accumulates in plants at the expense of calcium and potassium, while sodium is not considered a nutrient for plants. Salt-tolerant plant varieties maintain high calcium and potassium concentrations and vice versa maintain low sodium and chloride concentrations **(Patel *et al.*, 2010).** The highest ratio of susceptibility to high salinity.

Potassium to sodium in plants is one of the most important reasons that make plants tolerate salt **(Maathuis and Amtmann, 1999).** Among the manifestations of the effect of salt stress on plants is the decrease in rate of photosynthesis because chloroplasts activity lack and the high rate of photorespiration, which leads to a decrease in plant growth in general. Environmental changes surrounding the plant, such as high relative humidity, temperature, radiation and air pollution, lead to increase plant affected to salinity **(Shannon *et al*., 1997).**

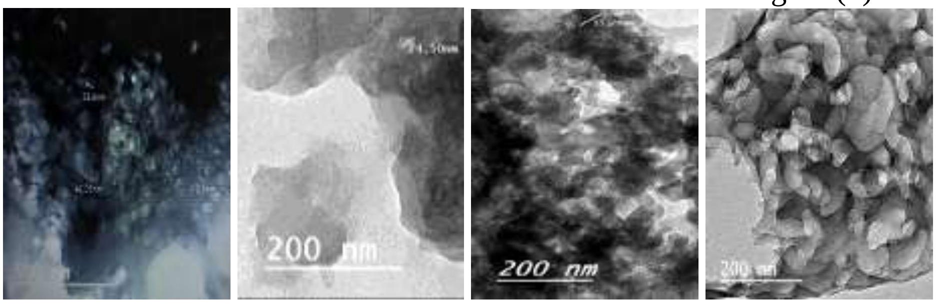
Biotechnological applications tend to use new materials in environmental treatment called bio-adsorption **(Japhe, *et al.*, 2015).** Biotechnological applications tend to use new materials in environmental treatment called bio-adsorption, materials used in this field, crustacean's shells, algae, fruit peels, egg shells, sawdust, nut shells, tea leaves, etc. **(Liu and Wang, 2009 and Kim *et al.*, 2017).** Agricultural wastes (Pomegranate banana and orange peels) are polyphenols compounds, lignin and cellulose that consider as a natural adsorbents and have the capacity to adsorb a number of metal ions **(Al-Rawahi *et al.*, 2014, Arora and Kuar, 2013 and Aboul-Enein *et al.*, 2016).**

Diatoms are a large group of silicate algae, most of which are unicellular. It is one of the most common types of phytoplankton in the seas and oceans. Although they can exist in the form of colonies in the form of strings or ribbons, fans, flats or colonies **(Wang and Seibert, 2017).** Silicon has many benefits for the plant, such as stimulating seed germination, resisting diseases pests, remediate nutrient imbalances, resisting water and salt stress. diatoms contain Si, lignin **(Wang and Seibert, 2017)** and total phenolic content **(Hemalatha *et al.*, 2013).**

The aim of this study, to exam the effect of some untraditional materials at nanosizes to mitigate salt stress on garlic plants at vegetative growth stage grown under salt stress in sandy soils.

MATRIAL AND METHODS

The untraditional materials as pomegranate peels, diatoms (silicate algae), banana peels and orange peels were collected and washed well using distilled water, while diatoms was washed until remove its salinity. All material were dried in hot oven at 105°C for 12 h, then the dried material were grinded very well using kitchen mill and sieved the obtained powder using 0.25 micrometer sieve and then regrind it again and the material powder sieved again. The passed powder was examined using Transmission Electron Microscope HRTEM, JEOL 3010 (TEM) to determine the size of materials in nanometers as shown in Figure (1).



(a) (b) (c) (d)

Fig. (1) TEM image a) pomegranate peel b) diatoms algae c) banana peel d) orange peel nanopowder.

The sandy saline soil was collected from Bani Salama Embaba area, Giza Governorate. Soil was dried and sieved with 2 mm sieve and then homogenized. Irrigation water was brought from a well used to irrigate plants in the same area. The some analysis were carried out on soil and irrigation water as follows: soil pH (using pH meter model WTW Series pH 720) was determined in 1:2.5 soil water suspensions according to the standard method described by **Richards (1954).** Total soluble salt (using EC meter model WTW Series Cond 720) occurred in soil paste extract as method described by **Jackson *et al.* (1973).** Total $CaCO_3$ content and soluble cations and anions were carried out according to **Jackson *et al.* (1973).** Nitrogen was determined by the micro Kjeldahl method according to **AOAC (2012).** Phosphorus was determined colorimetrically using spectrophotometer (model JENWAY6705UV/Vis) and potassium was determined using Flame-photometer (model JENWAYPFP7), according to **Jackson *et al.* (1973).** Available micronutrients were extracted by DTPA according to **Lindsay and Norvell (1978)** and determined using Atomic Absorption Spectrophotometer (model, analyticjenanovAA 350). Data presented in Table (1) and (2) showed that some physical and chemical characteristics of the sandy soils and irrigation water under study.

Table 1: Some physical and chemical characteristics of the studied soil

Soil characteristics	Value	Soil characteristics	Value
Particle size distribution%:		**Soluble cations ($mmol_c l^{-1}$)**	
Sand	95.55	Ca^{2+}	23.62
Silt	1.50	Mg^{2+}	22.28
Clay	2.95	Na^{+}	26.50
Textural class	Sandy*	K^{+}	0.11
Soil chemical properties:		**Soluble anions ($mmol_c l^{-1}$)**	
pH (1:2.5 soil water suspension)	7.60	CO_3^{2-}	0.00
ECe (dS m^{-1}, soil paste extract)	8.15	HCO_3^{-}	2.83
$CaCO_3$ %	3.21	Cl^{-}	24.18
Organic matter %	0.07	SO_4^{2-}	45.50

Available macro and micronutrients (mg kg^{-1})

N	P	K	Fe	Mn	Zn	Cu
33.42	7.21	95.80	0.41	0.22	0.25	0.18

*International texture triangle

Table 2: Some chemical characteristics of irrigation water

Characteristics		Value	
pH		6.80	
EC (dSm^{-1})		7.02	
Soluble cations ($mmol_c l^{-1}$)	Value	Soluble anions ($mmol_c l^{-1}$)	Value
Ca^{2+}	32.24	CO_3^{2-}	0.00
Mg^{2+}	26.92	HCO_3^{-}	1.42
Na^{+}	21.39	Cl^{-}	27.04
K^{+}	0.80	SO_4^{2-}	53.55

A pots experiment was conducted in the Agricultural Research Center, during two successive seasons 2019/2020 and 2020/2021. The cultivation was carried out in pots of 2 kg capacity, and the soil used saline soil was sandy collected , from Bani Salama Embaba area, Giza Governorate. The collected sandy soils were mixed, homogenized, sieved (< 0.25 mm). The pots were irrigated before planting, then three cloves of garlic (*Allium sativum* L. var. sids 41) were planted in each pot and re-irrigated again. Irrigation and fertilization program followed according to the Ministry of Agriculture. Untraditional materials such as pomegranate peels, bananas peels, orange peels, and diatoms powder (Fossilized silicates algae) were used as treatments added to garlic plants to reduce the salt stress of soil and irrigation water. Thirteen treatments as control, 0.15, 0.3 and 0.6 g from untraditional material at nanosize were applied and distributed in the soil surface of the pots with three replicates for each treatment arranged as complete at randomize block design. Treatments were applied each time at the day before application irrigation and fertilization for pots. Three garlic plants were collected from each treatments at the end of vegetative growth. Some growth parameters such as plant height (cm), number of leaves/ plant, fresh leaf weight (g), and leaf dry weight (g) were measured. Plant samples were oven dried at 70 °C, then fine grinded. Plant samples were digested using H_2SO_4+ $HClO_4$(1:1v/v) acid mixture to determine macro (N, P, K, Na and) and micronutrients (Fe, Cu, Mn and Zn) using micro-Kjelahel method, spectrophotometer, flam photometer and atomic spectrophotometer, respectively, according to **AOAC (2012)**, respectively. S content in plants was determined according to **Kurmanbayeva *et al.* (2017).** Photosynthetic pigment content as a, b and total chlorophyll and carotenoids content were determined in fresh leaves according to **Sumanta *et al.* (2014).** Proline in fresh leave was measured by ninhydrine method according to method described by **(Petronia and Yves, 2015).**

The data were statistically analyzed using analysis of variance test by the least significant difference (LSD at 0.05) according to method described by **Gomez and Gomez (1984)** using IBM SPSS Statistics 20 program (2020).

RESULTES AND DISCUSSION

Effect of untraditional materials at nanoscale on some growth parameters of garlic plants at vegetative growth under salt stress

As the obtained results of both successive seasons were not significantly different, their average was taken into consideration as **Bartlett (1937)** test was done to homogeneity of error variance. The test was not significant for all assessed trait, so, the two seasons' data were combined.

Growth parameters

Data in Table (3) show that some growth parameters of garlic plants at vegetative growth grown in sandy soil under salt stress.

Also, the data showed that some growth parameters i.e. plant height, number of leaves $plant^{-1}$, leaves fresh weight and leaves dry weight were significantly affected at the control treatment when grown in sandy soils with salts content of 8.15 (dS m^{-1}) and irrigated by irrigation water with 7.02 (dS m^{-1}) without any treatments with values were 47.37 (cm), 7.25 leaves $plant^{-1}$, 58.10 (g) and 9.88 (g) for each of the plant height, number of leaves $plant^{-1}$, leaves fresh weight and leaves dry weight, respectively.

On other hand, the data showed that, the garlic plants were applied by diatoms powder at nanoscale was more tolerant and resistant to salt stress than plants under other treatments. The results appeared that the values of some growth parameters of garlic plants at vegetative growth stage under salt stress with values were 55.53, 60.85 and 68.75 (cm), 7.50, 7.75 and 8.75 leaves/plant, 72.32, 72.51 and 73.77 (g), 0.27, 10.58 and 10.75 (g) for both of plant height, No. of leaves, leaves fresh weight and leaves dry weight with rates of 0.15, 0.3 and 0.6 (g) from diatoms nanopowder, respectively.

Also, the results recorded that the highest values (68.75 cm, 8.75, 73.77 (g) and 0.75 (g) of plant plant height , No. leaves, Leaves fresh weight and leaves weight (g) dry , respectively were obtained due to the treatments of diatoms powder addition at 0.6 (g/pot) nanopowder from the treatments as follows diatoms powder > pomegranate peel > banana peel > orange peel at nanoscale > control treatment according to tolerance of salinity.

Table (3) Effect of some untraditional materials at nanoscale on some growth parameters of garlic plants at vegetative growth stage grown under salt stress

Treatments		Plant height (cm)	No. of leaves	Leaves fresh weight (g)	Leaves dry weight (g)
Control		47.37	7.25	58.10	9.88
Pomegranate peels	0.15	55.33	7.40	65.25	10.23
	0.3	57.89	7.50	68.75	10.33
	0.6	65.78	8.25	71.82	10.50
	Mean	59.67	7.72	68.61	10.35
Diatoms powder	0.15	55.53	7.50	72.32	10.27
	0.3	60.85	7.75	72.51	10.58
	0.6	68.75	8.75	73.77	10.75
	Mean	61.71	8.00	72.87	10.53
Banana Peels	0.15	48.15	7.50	63.95	10.20
	0.3	52.80	7.75	68.44	10.32
	0.6	58.24	8.00	69.55	10.53
	Mean	53.06	7.75	67.31	10.35
Orange Peels	0.15	49.33	7.50	60.20	10.15
	0.3	50.76	7.50	65.45	10.33
	0.6	52.50	7.75	68.80	10.41
	Mean	50.86	7.58	64.82	10.30
LSD at 0.05		1.85	0.42	0.85	0.28

Figure (2) showed that the effect of using untraditional materials on increasing the dry weight of garlic plant leaves at vegetative growth stage under salt stress compared to the control treatment. The addition of untraditional materials at the nanoscale with treatment of 0.6 (g) increased the plant response to tolerance salt stress than the other treatments at other doses. Most of the fruit peels and diatoms (marine algae) contain potassium, vitamins, minerals and some essential elements which enhance the growth of plants **(Mercy *et al.,* 2014 and Zheng *et al.,* 2005).**

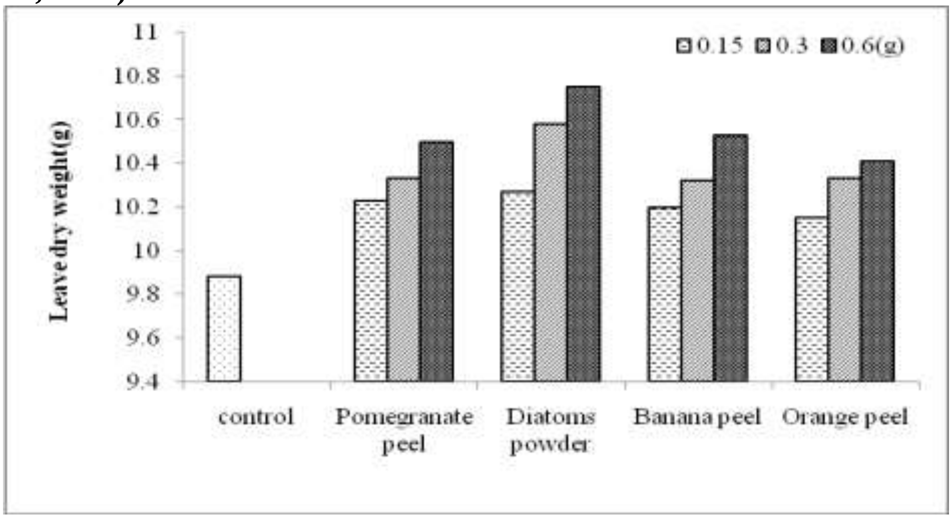


Fig. (2) Effect of untraditional materials at nanoscale on leave dry weight in garlic plants at vegetative growth stage under salt stress

Interaction analysis showed that some growth parameters of garlic plants at vegetative growth stage under salt stress were had a positive response to tolerance salt stress with add the untraditional materials as pomegranate peels, diatoms powder, banana peels and orange peels compared with control treatment**.** This result means that the untraditional materials at nanoscale treatments acted suitably on the growing garlic plants regarding to all the studied vegetative characters **(Shama *et al.*, 2016)**

Bio-chemical properties.

Data in Table (5) indicated that the photosynthetic pigments such as chlorophyll a, chlorophyll b, total chlorophyll and carotenoids were significantly varied with addition of untraditional materials to garlic plants during vegetative growth stage under salt stress as compared to the control treatment.

Although, addition of the untraditional materials at nanoscale led to an enhanced photosynthesis pigments of garlic plants at vegetative growth stage under salt stress, it differed among it in terms of response degree. The response of the garlic plant in vegetative growth stage was better with diatom powder treatment at nanoscale, especially when the treatment was applied to dose of 0.6 g.

Using of some materials to enhancement of chlorophyll and carotenoid pigments level , photosynthetic rate and modifying the activity of some of the important enzymes are led to mitigate of salt stress on plants **(Hayat *et al.*, 2007 and 2008).**

Table (4) Effect of some untraditional materials at nanoscale on some biochemical parameters of garlic plants at vegetative growth stage grown under salt stress

Treatment (g)		Chl. a	Chl. b	Total Chl.	Carotonids	Proline
				mg g^{-1} FW		
control		0.409	0.162	0.571	0.324	20.42
Pomegranate peels	0.15	0.440	0.207	0.647	0.356	32.23
	0.3	0.461	0.214	0.675	0.379	34.35
	0.6	0.474	0.231	0.705	0.387	37.52
	Mean	0.460	0.220	0.680	0.370	34.70
Diatoms powder	0.15	0.463	0.219	0.682	0.399	34.20
	0.3	0.484	0.225	0.709	0.408	37.12
	0.6	0.510	0.236	0.746	0.416	39.45
	Mean	0.490	0.230	0.710	0.410	36.92
Banana peels	0.15	0.420	0.179	0.599	0.343	29.64
	0.3	0.443	0.207	0.650	0.349	31.25
	0.6	0.457	0.226	0.683	0.374	32.52
	Mean	0.440	0.200	0.640	0.360	31.14
Orange peels	0.15	0.415	0.175	0.590	0.333	24.53
	0.3	0.435	0.200	0.635	0.342	27.34
	0.6	0.444	0.209	0.653	0.364	29.23
	Mean	0.430	0.200	0.630	0.350	27.03
LSD at 0.05		0.03	0.02	0.02	0.02	0.62

Also, data in Table (5) showed that the interaction effect of untraditional materials at nanoscale and garlic plants at vegetative growth under salt stress on proline content with values arranged between 24.53 to 39.45 mg g^{-1} FW, and control treatment was less value (20.42 mg g^{-1} FW) as shown in Figure (3). It was evident from the results that addition of untraditional materials at nanoscale helped garlic plants at vegetative growth stage to tolerance salt stress by stimulating garlic plants to form proline. Use of untraditional materials at nanoscale with the garlic plants at vegetative growth stage grown in sandy soils under salt stress led to stimulating proline production, which led to mitigate salt stress **(Turan *et al.,* 2009 and Butt *et al.,* 2016).** The increased accumulation of proline lead to enhanced photosynthetic efficiency and ATP production, resulting in greater saline water use efficiency **(Guo *et al.,* 2015).** The harmful effects of irrigation with saline water on garlic plants might be related to the injurious effect of specific ions such as Na^+ and Cl^-, which inhibited the production of chlorophyll and carotonids in leaves **(Al-Safadi and Faoury, 2004).**

Interaction analysis showed that some biochemical parameters of garlic plant at vegetative growth stage grown under salt stress were there more response to tolerance salt stress with add the untraditional materials at nanoscale compared with control treatment.

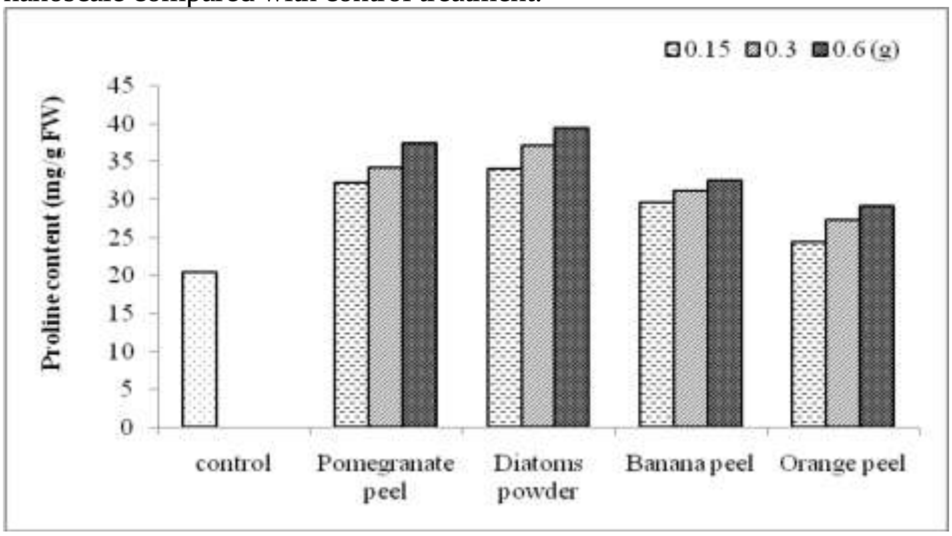


Fig. (3) Effect of untraditional materials at nanoscale on Proline content in garlic plant at vegetative growth stage under salt stress

3) Effect of untraditional materials at nanoscale on macro, micro-nutrients and S contents of garlic plants at vegetative grown stage under salt stress

The data in Table (5) show the macro, micro-nutrients and S contents of garlic plants at vegetative growth stage under salt stress, which reflects the nutritional status of garlic plants under this state compared with control treatment.

Also, the results in Table (5) showed macro, micro-nutrients and S contents of garlic plants at vegetative growth stage under salt stress, which reflects the nutritional status of garlic plants under this state this mean that the untraditional materials at nanoscale were effective to reduced salt stress especially diatoms powder at dose 0.6 (g) **(Fawzy *et al.*, 2012).**

Furthermore, data were presented that using untraditional materials at nanoscale were promoted increase plant response to accumulate macro, micro and S-nutrients in vegetative parts of garlic plants under salt stress. Whereas, the contents of garlic plants at vegetative growth stage under salt stress differ from macro and micro-nutrients according to materials were using and the weight was taken from it. Soil fertility was increase with increasing of macro-nutrients with using untraditional nanomaterials **(Abou Basha *et al.*, 2013 and Mercy *et al.*, 2014)**

Table (5) Effect of some untraditional materials at nanoscale on macro, micro-nutrients and sulfur contents of garlic plants at vegetative grown stage under salt stress

Treatments		N	P	K	Fe	Mn	Zn	S %
		%			mg kg^{-1}			
Control		1.04	0.08	1.35	0.50	10.35	11.24	0.20
Pomegranate peels	0.15	1.85	0.13	1.58	0.66	12.05	11.58	0.25
	0.3	2.00	0.17	1.62	0.68	12.40	11.84	0.28
	0.6	2.45	0.18	1.68	0.71	12.86	12.00	0.33
	Mean	2.10	0.16	1.63	0.63	12.44	11.81	0.29
Diatoms powder	0.15	2.01	0.15	1.69	0.70	12.23	11.62	0.31
	0.3	2.26	0.18	1.71	0.75	12.78	12.15	0.33
	0.6	2.56	0.19	1.75	0.77	13.15	12.56	0.37
	Mean	2.28	0.17	1.72	0.74	12.72	12.11	0.34
Banana peels	0.15	1.25	0.12	1.45	0.62	11.80	11.25	0.25
	0.3	1.90	0.14	1.53	0.64	11.85	11.56	0.25
	0.6	2.15	0.17	1.58	0.65	11.88	11.90	0.30
	Mean	1.77	0.14	1.52	0.64	11.84	11.57	0.27
Orange peels	0.15	1.18	0.10	1.42	0.58	11.11	11.22	0.22
	0.3	1.33	0.12	1.48	0.58	11.42	11.34	0.23
	0.6	1.40	0.15	1.50	0.59	11.45	11.52	0.26
	Mean	1.30	0.12	1.47	0.58	11.33	11.36	0.24
LSD at 0.05		0.03	0.02	0.03	0.01	0.30	0.06	0.02

Therefore, data was found that the content of garlic plants at vegetative growth stage and grown in sandy soils affected by salts, from macro and micro-nutrients with values were (0.25, 0.28, 0.33%), (0.31, 0.33, 0.37%), (0.25, 0.25. 0.30,%) and (0.22. 0.23, 0.26%) of S contents for each of pomegranate peels, diatoms powder, banana peels and orange peels nanoscale at applied doses of 0.15, 0.3 and 0.6 (g), respectively, as shown in Figure (4).

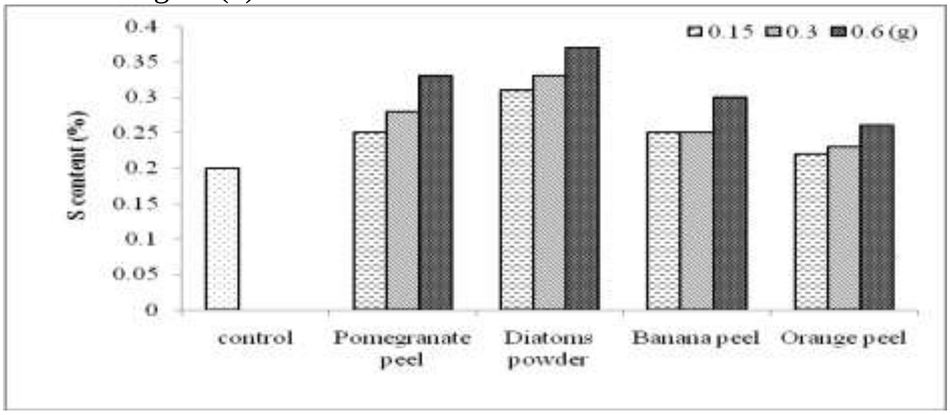


Fig. (4) Effect of untraditional materials at nanoscale on sulfur content in garlic plants at vegetative growth

The untraditional materials at nanoscale stimulate plant development by the assimilation of macro, micro-nutrients and S contents, enzyme activation and /or inhabitation, changes in membrane permeability and finally the activation of dry matter production **(Shafeek *et al.*, 2016 and El-Metwally and Salama, 2019).**

Finally, the results showed that responses of macro and micro-nutrients contents in garlic plants at vegetative growth under salt stress seemed to be more efficient with diatoms nanopowder applied at dose of 0.6 (g).

Effect of untraditional materials at nanoscale on sodium and potassium contents and K^+/Na^+ ratio of garlic plant grown under salt stress

The data in a Table (6) indicated that there was a response to reducing salt stress on garlic plants at vegetative growth stage grown in sandy soil when using untraditional materials at nanoscale such as pomegranate, bananas and oranges peels as well as diatoms powder in three doses were 0.15, 0.3 and 0.6 (g) compared to the control treatment.

Sodium content in garlic plants at vegetative growth stage under salt stress was high with control treatment compared with other treatments. On the other hand, sodium content was decreased with using untraditional materials at nanoscale especially with diatoms treatment applied at dose of 0.6(g).

Table (6) Effect of some untraditional materials at nanoscale on sodium content of garlic plant grown under salt stress

Treatments		K^+	Na^+	K^+/Na^+
		%		
Control		1.33	10.44	0.14
Pomegranate peels	0.15	2.22	9.32	0.24
	0.3	2.85	8.98	0.32
	0.6	3.11	8.64	0.36
	Mean	2.73	8.98	0.31
Diatoms powder	0.15	2.32	9.17	0.25
	0.3	3.15	8.85	0.36
	0.6	3.60	8.55	0.42
	Mean	3.02	8.86	0.34
Banana peels	0.15	2.11	9.64	0.22
	0.3	2.64	9.15	0.29
	0.6	2.90	8.84	0.33
	Mean	2.55	9.21	0.28
Orange peels	0.15	1.89	9.85	0.19
	0.3	2.05	9.24	0.22
	0.6	2.45	9.05	0.27
	Mean	2.13	9.38	0.23

The results revealed that the untraditional materials at nanoscale increased potassium content in garlic plants at vegetative growth stage under salt stress with values were (2.22, 2.85, 3.11%), (2.32, 3.15, 3.60%), (2.11, 2.64, 2.90%) and (1.89, 2.05, 2.45%) for K content at pomegranate peels, diatoms powder, banana peels and orange peels at applied doses of 0.15, 0.3 and 0.6 (g), respectively. Improving garlic plants growth and biochemical parameters, macro and micro-nutrients contents with using untraditional materials at nanoscale as pomegranate peels, diatoms powder, banana peels and orange peels led to increase K^+/Na^+ ratio and this led to mitigate salt stress on garlic plants at vegetative growth stage grown in sandy soils under salt stress. Also, data was noticeable that the ratio of potassium to sodium in all treatments from untraditional materials at nanoscale as pomegranate peels, diatoms powder, banana peels and orange peels with three doses were 0.15, 0.3 and 0.6 (g) was high compared to the control treatment as shown in Figure (5).

Furthermore, promoted increase potassium ratio in garlic plants at vegetative growth stage under salt stress led to reduce the competition between sodium and potassium and increased mitigate of salt stress **(Zheng *et al.*, 2005, Munis *et al*., 2010 and Mercy *et al.*, 2014).**

Finally, high salts lead to osmotic stress around plant's roots, and this leads to a clear decrease in the rate of plant growth **(Yongchao *et al.*, 2015)**. Adding traditional materials at nanoscale as pomegranate peels, diatoms powder, banana peels and orange peels which contain polyphenols compounds, lignin, cellulose that consider as a natural adsorbents and have the capacity to adsorb a number of metal ions **(Arora and Kuar, 2017)**, and silicon led to improving the plant contents of photosynthetic pigments, improving the percentage of carbon dioxide among the plant's cells, improving the stomatal conductance and then improving the rate of photosynthesis of the plant **(Imtiaz *et al.*, 2016).** Growing plants under salt stress lead to decreasing in the overall growth rate of plant, and thus silicon plays an important role to making plant tolerance salt stress **(Xu *et al.*, 2015)**. Silicon as a significant component in diatoms (silicate algae) plays an important role in reducing salt stress on plants, as it works to reduce the rate of transpiration due to the deposition of silicon under the epidermal cells of leaves and stems **(Trenholm *et al.*, 2004 and Yongchao *et al.*, 2015).**

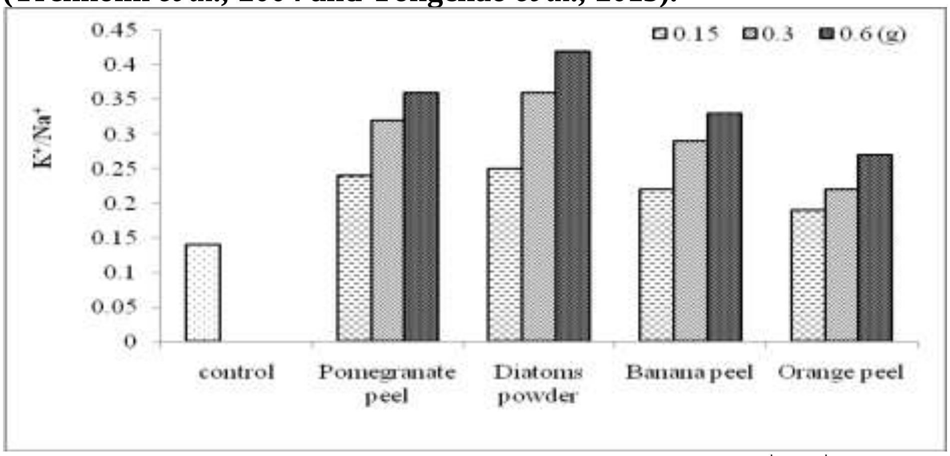


Fig (5) Effect of untraditional materials at nanoscale on K^+/Na^+ in garlic plants at vegetative growth under salt stress

CONCLUSSION

From the above data , it could be concluded that, use of untraditional materials at nanoscale as pomegranate peels, diatoms powder, banana peels and orange peels were mitigate salt stress effect on garlic plants at vegetative growth stage grown in sandy soils under salt stress. The materials differed among it to mitigate the salt stress on garlic plants. The results showed that diatoms nanopowder applied at a dose of 0.6 (g) was more effective than other materials under study in mitigating the salt stress on garlic plants at vegetative growth stage grown in sandy soils under salt stress.

The issue requires, in the future, more study and research, to obtain highquality and quantity productivity of garlic, with low cost.

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تخفيف الإجهاد الملحي باستخدام مواد غير تقليدية وتاثير ذلك على النمو الخضري لنباتات الثوم المزروعة في التربة الرملية

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أقيمت في مركز البحوث الزراعية بالجيزة ، مصر ، تمت زراعتها بنباتات الثوم (*Allium sativum* L., var. sids 41) خلال موسمي 2019 – 2020 و 2020 – 2020. تم طحن المواد غير التقليدية بمطحنة المطبخ وفحصها بواسطة المجهر الإلكتروني النافذ (TEM). تم تطبيق ثلاثة عشر معاملة هي قشور الرمان ، مسحوق الدياتومات ، قشور الموز وقشور البرتقال بالمقياس النانوى بثلاث معدلات هي 0,15 و 0,3 و 0,6 (جم) ومعاملة المقارنة. يهدف هذا البحث إلى دراسة تأثير بعض المواد غير التقليدية بمقياس النانو على تخفيف الضغط الملحي على نباتات الثوم في مرحلة النمو الخضري المزروعة في التربة الرملية المتأثرة بالأملاح. أظهرت البيانات أن مسحوق الدياتومات النانوى بجرعة 0,6 (جم) كانت أفضل معاملة لتخفيف الإجهاد الملحي على نباتات الثوم في مرحلة النمو الخضري تحت الضغط الملحي المزروع في التربة الرملية.