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Effect of Foliar Applications with some Nutritive Compounds on Garlic Yield and its Components in a Sodic Soil

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TWO field experiments were carried out at a private farm in Dyarb- Negm, Sharkia Governorate during two successive winter seasons 2005/2006 and 2006/2007 to study the effect of foliar spray application of two organic plant nutritive compounds, which contain micronutrients (Nofatrein and Setrein) at rates of 0, 1.5, 3 and 4.5 l/fed on total yield, quality and components of garlic bulb under alkaline soil conditions.

The obtained results indicated that foliar application of each of Nofatrein and Setrein at different rates to garlic bulb led to a significant increases in total yield, exportable yield, marketable yield, average weight of bulb, bulb dry matter N, P, K, Fe, Mn, Zn, content and uptake, volatile oil yield, total carbohydrates and total protein there were significant increases within all treatments. The maximum values of total yield of garlic bulb were obtained from D and H treatments (4.5 l/fed) Nofatrein or Setrein in the 1st season reached to 9.7 and 9.92 Mg/fed for while in the 2nd season were 10.08 and 10.29 Mg/fed respectively, resulting in maximum values of response percent over control in both seasons compared to un-sprayed control. The weight loss percentage of bulbs increased during storage period in both seasons. NO^{--}_3 content in garlic bulb under different treatments were in the save limits as well as total yield and its components under such alkaline soil conditions.

Keywords: Alkaline soil, Foliar application of nutritive compounds, Garlic.

Garlic (*Allium sativum* L.) is one of the old vegetable crops in Egypt. It is considered as an economic crop for local consumption and exportation. Balady variety the dominate one in Egypt should meet more attention for increasing productivity and improving bulb quality through decreasing the P, K mineral doses and spraying micronutrient to reduce the harmful free NO^{--}_3 content in edible food (Swann, 1975).

Application of micronutrients has an economic role in decreasing the cost of the used soluble micronutrients which unfortunately in case of soil application which converted to insoluble forms. So, foliar spray overcomes this problem

Hegab *et al.* (1987). On the other hand, Negm *et al.* (2004) found that spraying with both Fe and Zn in different forms and rates gave significant increases in yield and Fe, Zn and K uptake for sorghum plant.

According to Nofatrein and Setrein pamphlets, foliar application of them has a very important environmental goal as it minimize pollution of soil with mineral fertilizers and hence reducing its mobility to under ground water or surface water. Thus, the aim of this work was to study that effect as plant nutritive compounds contain micronutrients at four rates on garlic yield, quality and its components under alkaline soil conditions.

Material and Methods

Two field experiments were carried out during the two excessive winter seasons of 2005-2006 and 2006-2007 at a private farm in Dyarb Negm County, El-Sharkia Governorate. Nofatrein and Setrein compounds are commercial products and recommended by the General Organization for Agricultural Equaliztion Fund (GOAEF), Ministry of Agriculture and these compounds as organic plant nutritive supported by Fe, Mn, Zn, B, Mo in chelated forms.

In this work the different foliar application rates from Nofatrein and Strein to garlic were conducted under alkaline soil conditions according to the classification of and FAO (1988), as their (EC < 4 dS/m, PH > 8.5 and ESP > 15%). Table 1 shows some physical and chemical characteristics of the studied soil according to Page *et al.* (1982) and Klute (1982) .

TABLE 1. Some physical and chemical properties of the soil under study.

(a) Physical properties							
Season	Coarse sand %	Fine sand %	Silt %	Clay %	Textural class	$CaCO_3$ %	O. M %
1st	5.26	21.71	27.65	45.38	Clay	2.97	2.41
2nd	5.19	20.30	28.30	46.21	Clay	2.49	2.52

(b) Chemical properties														
Season	SP	E.C dS/m	PH	Ion concentration in paste extract (mmol$_c$/l)								SAR	E.S.P	C.E.C cmol$_c$ kg^{-1}
				Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO^{--}_3	HCO^{-}_3	Cl^{-}	SO^{--}_4			
1st	90	1.86	8.57	5.20	3.50	6.70	0.35	-	2.10	8.40	5.25	3.21	18.63	38.52
2nd	88	1.67	8.46	5.91	3.10	5.83	0.40	-	1.82	6.79	6.53	2.75	16.71	39.41

(c) Extractable nutrients mg/kg soil						
Element	N	P	K	Fe	Mn	Zn
1st	70.5	22.8	904	28.4	15.1	6.4
2nd	74.6	23.1	902	27.7	14.6	5.8

A split-plot design with four replicates was used. The main treatments were Nofatrein (Nof) and Setrein (Set) and rates as sub main treatments corresponding the possible combinations were (A) 0 Nof/fed, (B) 1.5 L Nof/fed, (C) 3 L Nof/fed, (D) 4.5 L Nof/fed, (E) 0 Set/fed, (F) 1.5 L Set/fed, (G) 3 L Set/fed and (H) 4.5 L Set/fed. Table 2 presents the chemical composition of both Nofatrein an Setrein compounds.

TABLE 2. Chemical composition of Nofatrein and Setrein compounds (%).

Compound	Fe	Mn	Zn	N	P	K	B	Mo
Nofatrein	0.15	0.1	0.05	5	5	5	0.05	0.05
Setrein	2.0	2.0	2.0	15%*	3 %**			

* in active citric acid . ** a cohesive substance .

Each experimental plot contained 7 rows, 0.6 meter in width and 3.5 meters in length. Garlic cloves were selected uniformity in shape and size. They were sown at 10 (cm) apart on both sides the row. On the 10^{th} of September for both seasons. All plots were fertilized with calcium super phosphate (15.5% P_2O_5), at rates of 30 kg/fed P_2O_5, during soil preparation, while potassium sulphate (48% K_2O) and ammonium sulfate (20.6%N) at rates of 45 kg K_2O and 60 kg N/fed on equal three doses after 4, 8 and 12 weeks from planting.

Concerning to foliar application of Nofatrein and Setrein, 1.5 l/fed added after 4 weeks of planting, 3.0 l/fed were equally added after 4 and 8 weeks from planting, while 4.5 l/fed were equally added after 4, 8 and 12 weeks from planting.

Method of analyses and data recording

A . Yield and its components

At maturity the yield of every plot graded for different sizes to obtain uniform bulbs. Plants were placed for cured about two weeks in the shady place then tops and roots were removed and graded into four categories according to bulb diameter laid down by the Ministry of Economic guides for garlic exportation (1963) as follows:

Grade 1- (above 5.5 cm), Grade 2- (4.5- 5.5 cm), Grade 3- (3.5- 4.4 cm) and Grade 4- (less than 3.5 cm). Each grade was weighted separately and classified as follows:

Exportable yield (grades 1 and 2). Marketable yield (grades 1 – 3). Total yield (the 4 grades).

$$\text{Average cured weight} = \frac{\text{yield of bulb/plot}}{\text{total number of bulbs/plot}}$$

B. Bulb quality at maturity

1. Macro nutrient N, P and K contents were determined in bulbs of garlic plants according to Page *et al.* (1982) and there amounts (uptake) in bulbs of these nutrients were calculated (mg/plant).

2. Micronutrient Fe, Mn and Zn contents were determined using atomic absorption spectrophotometer page *et al.* 1982 and their amounts (uptake) in bulbs were calculated (mg/plant).

3. Nitrate content (NO_3^- mg/kg plant) was determined by modified method of Singh (1988).

4. Total carbohydrate (%) was determined according to the methods described by (Dubois *et al.*, 1956).

5. Total protein (%) was calculated by multiplying total nitrogen x 6.25.

6. Volatile oils were determined in bulb tissue at maturity (oil yield of garlic litter/fed) according to the method of Guenther (1961).

7. Weight loss %; bulbs of each treatment were weighted at 30 day intervals then the cumulative weight loss percentage was calculated.

C. *Statistical analysis*

All obtained data were subjected to statistical analysis of variance, and the least significant differences (L.S.D) at 5% level of error probability were calculated as mentioned by Snedecor & Cochran (1980).

Results and Discussion

1. Grade and total yield and its components

Data in Table 3 revealed that foliar application of Nofatrein and Setrein at different rates led to significant increases in yield of each grad and the total of them compared with the control (0). The highest values of all parameters were recorded at the rate of 4.5 l/fed in both seasons. Results showed that the highest increments of average weight of grade 1 and 2 of bulbs led to increase all components (total yield, exportable and marketable).

The favorable effect of foliar application of Nofatrein and Seterin on total yield and its components could be explained due to the great role of these compounds in enhancing growth rate, which exert direct effect on the yield and its components. In this context the highest values of total, exportable and marketable yields were obtained by D and H treatments in both seasons.

On the other hand, the high values of total yield in the first seasons were 9.70 and 9.92 Mg/fed for Nofatrein and Setrein treatments respectively and the high values in the second seasons were 10.08 and 10.19 Mg/fed for Nofatrein and Setrein respectively. Also total exportable and total marketable ones took the same trend of total yield in both seasons.

Furthermore, the lowest values of total garlic yield and its components were with the non-sprayed treatment (0) and the sharply increased values were with the sprayed D and H treatments with both Nofatrein and Setrein. Setrein was more effective on increasing total yield and its components.

TABLE 3.a. Effect of foliar application of Nofatrein and Setrein on graduated yields of garlic bulb (Mg/fed).

Characters / Treatments l/fed		Grade 1			Grade 2			Grade 3			Grade 4		
		S1	S2	Mean	S1	S2	Mean	S1	S2	Mean	S1	S2	Mean
Nofatrien	0	2.83	3.23	3.03	1.71	1.79	1.75	1.16	1.19	1.18	0.55	0.52	0.54
	1.5	3.25	3.37	3.31	2.40	2.32	2.36	1.13	1.22	1.18	0.58	0.65	0.62
	3.0	3.70	3.96	3.83	2.57	2.21	2.39	1.31	1.69	1.45	0.66	0.55	0.61
	4.5	4.61	4.90	4.76	2.72	2.56	2.64	1.33	1.58	1.46	1.04	1.04	1.04
	Mean	3.60	3.86	3.73	2.35	2.22	2.29	1.23	1.45	1.34	0.71	0.69	0.70
Sterein	0	2.83	3.23	3.03	1.71	1.79	1.75	1.16	1.19	1.18	0.55	0.52	0.54
	1.5	3.36	3.87	3.62	2.56	2.32	2.44	1.43	1.41	1.42	0.44	0.48	0.46
	3.0	3.81	4.10	3.96	2.60	2.08	2.34	1.18	1.40	1.29	0.82	1.06	0.94
	4.5	4.68	5.22	4.95	2.89	2.40	2.66	1.67	1.60	1.64	0.68	1.07	0.87
	Mean	3.67	4.11	3.89	2.44	2.15	2.30	1.36	1.400	1.38	0.622	0.782	0.70
Mean of level	0.0	2.83	3.230	3.03	1.71	1.79	1.75	1.16	1.19	1.18	0.550	0.520	0.54
	1.5	3.31	3.62	3.47	2.48	2.32	2.40	1.28	1.32	1.30	0.510	0.57	0.54
	3.0	3.76	4.030	3.90	2.59	2.15	2.37	1.25	1.60	1.43	0.74	0.81	0.77
	4.5	4.65	5.06	4.86	2.81	2.48	2.65	1.53	1.60	1.57	0.86	1.06	0.92
$LSD_{0.05}$ type		n. s	0.18	0.07	0.02	n. s	n. s	0.02	0.02	n. s	n. s	0.02	n. s
$LSD_{0.05}$ level		0.26	0.09	2.18	0.07	0.21	0.04	0.06	0.06	n. s	0.04	0.06	0.06
$LSD_{0.05}$ inter		n. s	0.13	0.13	0.10	n. s	2.18	0.08	0.08	n. s	0.06	0.08	0.08

TABLE 3.b. Total, marketable and exportable yields of bulbs (Mg/fed).

Characters / Treatments l/fed		Total Y (*)			Exportable Y (**)			Marketable Y (***)		
		S1	S2	Mean	S1	S2	Mean	S1	S2	Mean
Nofatrein	0	6.25	6.73	6.49	4.54	5.02	4.78	5.70	6.21	5.96
	1.5	7.36	7.56	7.46	5.65	5.69	5.67	6.78	6.91	6.85
	3.0	8.24	8.51	8.41	6.27	6.17	6.22	7.58	7.96	7.77
	4.5	9.70	10.08	9.90	7.33	7.46	7.40	8.66	9.04	8.85
	Mean	7.89	8.224	8.06	5.95	6.09	6.02	7.18	7.53	7.36
Setrein	0	6.25	6.73	6.49	4.54	5.02	4.78	5.70	6.21	5.96
	1.5	7.79	8.08	7.94	5.92	6.19	6.06	7.35	7.60	7.48
	3.0	8.41	8.64	8.53	6.41	6.18	6.30	7.59	7.58	7.59
	4.5	9.92	10.29	10.11	7.57	7.62	7.60	9.24	9.22	9.25
	Mean	8.09	8.44	8.27	6.11	6.25	6.189	7.47	7.65	7.56
Mean of level	0.0	6.25	6.73	6.49	4.54	5.02	4.78	5.70	6.21	5.96
	1.5	7.58	7.82	7.70	5.79	5.94	5.86	7.07	7.31	7.19
	3.0	8.36	8. 58	8.47	6.37	6.18	6.28	7.62	7.64	7.63
	4.5	9.81	10.19	10.00	7.45	7.54	7.50	8.95	9.13	9.15
$LSD_{0.05}$ type		n. s	0.16	0.01	0.09	n. s	n. s	0.16	0.16	0.04
$LSD_{0.05}$ level		0.11	0.24	0.98	0.06	0.27	0.11	0.09	0.14	0.04
$LSD_{0.05}$ inter		0.16	n. s	5.63	0.08	n. s	0.16	0.13	0.19	0.06

(*) Summation of the 4 grades.
(**) Summation of the 1st, 2nd, 3rd grades.
(***) Summation of the 1st and 2nd grades.

Generally, these results can be explained due to the simulative effect of foliar application of Nofatrein and Setreien on yield and its components as they contain mixture of nutrients which enhance plant growth rate and exert a direct effect on yield and its components. The role of these micronutrients was clear in photosynthesis in leaves. The importance of micronutrients in many biochemical process in addition to activation of several enzymes especially SH-enzymes which increase planting growth, yield and endogenous parameters of plant involve in the main metabolic process especially with energy co-enzymes, carbohydrates and protein metabolism and improve biosynthetic activity. These results are in harmony with those obtained by Khalil (1999); El-Seifi *et al.* (2004); Negm *et al.* (2004); Ranjbar & Bahmaniar (2007) and Shaheen *et al.* (2008).

2. Bulb fresh and dry matter weights .

Data presented in Table 4 pointed out that average weight values of bulb, bulb dry mater, dry mater, and the response percent over control were significantly increased as affected by the different foliar application treatments of both Nofatrein and Setrein compared with the control (0). The lowest values of all parameters were with the unsprayed treatment while the highest values were with (D) and (H) treatments for Nofatrein and Setrein in both seasons.

Concerning to the average weights of bulb, the high values in the first season were 57.74 and 58.93 gm/plant and in the second season were 60 and 61.25 gm/plant for (D) and (H) treatments, respectively. Likewise bulb dry matter and the response per cent over control took the same trend of average weight of bulb in both seasons, where the maximum values were at (D) and (H) treatments in both seasons.

3. NPK contents in garlic bulb and their uptake

Data in Table 5 indicates a significant increase in total NPK content as influenced by foliar application of Nofatrein and Strein in comparison with control and the highest value was obtained with (D) and (H) treatments in the two seasons. It is worthy to say that the values of both parameters in second season is higher than those obtained in the first season, this is attributed to, relative improvement in soil properties (Table 1), and consequently more availability of nutrient elements therewithal responsibility of plant to foliar application of nutrients, these results were in agreement with that obtained by Hassan *et al.* (2004). On the other hand there are significant differences among (D) and (H) treatments in the two seasons.

Concerning to the effect of foliar application on NPK uptake (Table 6). revealed a positive significant increase in all treatments in both seasons compared with control and also indicated that the maximum values of NPK uptake were found in the (D) and (H) treatments (4.5 l/fed Nofatrein or Setrein).

TABLE 4. Effect of foliar application of Nofatrein and Setrein on bulb dry matter, average weight of bulb, bulb dry matter and response percent over control.

Characters / Treatments l/fed		gm / plant (F.W) Average weight of bulb			gm / plant (D.W) Bulb dry matter			Response percent over control		
		S1	S2	Mean	S1	S2	Mean	S1	S2	Mean
Nofatrein	0	37.20	40.06	38.63	9.73	9.91	9.82	100.00	100.00	100.00
	1.5	43.81	45.00	44.41	10.13	10.30	10.22	117.76	112.33	115.05
	3.0	49.41	50.66	50.04	12.15	12.37	12.26	132.82	126.46	129.64
	4.5	57.74	60.00	58.87	13.05	13.26	13.16	155.21	149.78	152.50
	Mean	47.04	48.93	47.99	11.27	11.46	11.37	126.45	122.14	124.30
Setrein	0	37.20	40.04	38.63	9.73	9.91	9.17	100.00	100.00	100.00
	1.5	46.40	48.10	47.25	10.20	10.31	10.26	124.73	120.06	122.40
	3.0	50.06	51.43	50.75	12.45	12.52	12.49	134.57	128.38	131.48
	4.5	58.93	61.25	60.22	13.17	13.52	13.35	158.41	152.89	155.65
	Mean	48.15	50.21	49.18	11.24	11.39	11.46	129.43	125.33	127.38
Mean of level	0.0	37.20	40.06	38.63	9.37	9.21	9.82	100.00	100.00	100.00
	1.5	45.11	46.55	45.83	10.17	10.31	10.30	121.25	116.20	118.73
	3.0	49.74	51.05	50.40	12.30	12.45	12.38	133.70	127.42	130.56
	4.5	58.34	60.62	59.48	13.11	13.39	13.25	156.81	151.34	154.08
$LSD_{0.05}$ type		0.63	0.95	0.77	n. s	n. s	n. s	n. s	1.81	1.50
$LSD_{0.05}$ level		0.89	1.00	0.59	0.04	0.06	0.52	0.76	2.53	1.35
$LSD_{0.05}$ inter		n. s	1.41	0.83	0.06	n. s	n. s	1.08	3.58	1.40

TABLE 5. Effect of foliar application of Nofatrein and Setrein on N P K content in garlic bulbs.

Characters / Treatments l/fed		N %		P %		K %	
		S1	S2	S1	S2	S1	S2
Nofatrein	0	1.63	1.67	0.216	0.225	1.40	1.42
	1.5	2.16	2.14	0.252	0.288	1.92	1.95
	3.0	2.20	2.27	0.254	0.320	1.98	2.10
	4.5	2.32	2.36	0.270	0.324	2.11	2.13
	Mean	2.08	2.11	0.248	0.289	1.85	1.90
Setrein	0	1.63	1.67	0.216	0.225	1.40	1.42
	1.5	2.14	2.17	0.254	0.310	1.94	1.96
	3.0	2.25	2.28	0.256	0.324	1.99	2.12
	4.5	2.34	2.39	0.288	0.334	2.13	2.14
	Mean	2.09	2.13	0.253	0.298	1.87	1.91
Levels of type	0.0	1.63	1.67	0.216	0.225	1.40	1.42
	1.5	2.15	2.15	0.253	0.299	1.93	1.95
	3.0	2. 22	2.27	0.255	0.322	1.98	2.11
	4.5	2.33	2.38	0.279	0.329	2.12	2.13
$LSD_{0.05}$ type		0.02	n. s	n. s	0.020	n. s	n. s
$LSD_{0.05}$ level		0.01	0.01	0.01	0.01	0.04	0.01
$LSD_{0.05}$ inter		0.02	0.02	0.02	n. s	n. s	n. s

TABLE 6. Effect of foliar application of Nofatrein and Setrein on N, P and K amounts in garlic bulbs.

Characters / Treatments l/fed		N (mg / Plant)			P (mg / Plant)			K (mg / Plant)		
		S	S2	Mean	S1	S2	Mean	S1	S2	Mean
Nofatrein	0	158.60	165.50	162.05	21.17	22.30	21.74	136.22	140.72	138.47
	1.5	218.81	220.42	219.62	25.53	29.66	27.60	194.50	200.58	196.68
	3.0	267.30	280.80	274.05	30.66	39.58	35.12	240.57	259.77	250.17
	4.5	302.76	312.94	307.85	35.18	42.96	39.07	274.93	282.44	278.69
	Mean	236.87	244.92	240.90	28.14	33.63	30.89	210.31	220.95	215.63
Setrein	0	158.60	165.50	162.05	21.17	22.30	21.74	136.22	140.72	138.47
	1.5	218.28	219.60	218.94	25.91	31.96	28.94	197.88	202.08	199.98
	3.0	281.70	285.46	283.85	31.87	40.57	36.22	247.76	265.42	256.59
	4.5	308.18	323.13	315.86	37.93	45.16	41.55	280.05	289.33	284.69
	Mean	241.69	248.42	236.4	21.17	22.30	32.11	215.48	224.39	219.94
Mean of level	0.0	158.60	165.50	162.05	29.22	25.00	21.74	136.22	140.72	138.47
	1.5	218.55	220.01	219.28	25.72	30.81	28.27	196.19	201.47	198.83
	3.0	274.50	283.13	278.95	31.27	40.08	35.67	244.17	262.60	253.39
	4.5	306.97	318.04	311.86	36.56	44.06	40.31	277.49	285.89	281.69
$LSD_{0.05}$ type		n. s	n. s	n. s	0.28	n. s	n. s	n. s	n. s	n. s
$LSD_{0.05}$ level		0.63	25.68	n. s	1.12	0.89	1.87	0.92	25.64	25.23
$LSD_{0.05}$ inter		0.89	n. s	40.6	n. s	n. s	n. s	1.30	n. s	n. s

It is better to say that the positive effect of Setrein compound maybe due to its micronutrient contents and active citric acid which may absorbe by leaves of plant and enhancing photosynthesis, thereby increase chemical contents in different plant tissues these results are in harmony with those of Gouda (2002); Hassan *et al.* (2004) and Shaheen *et al.* (2008).

4. Micronutrient contents in garlic bulb and their uptake

It is clear from Table 7 that all treatments led to increasing in micronutrients as compared with control. The highest values were obtained at the treatment (4.5 l/fed) of both (D) and (H) treatments. This might be due to the enhancing effect of active citric acid and micronutrients on some metabolic activities in the plants. The same results were obtained by Deyab (1989); Raffat & Balbaa (2001) and Negm *et al.* (2004).

TABLE 7. Effect of foliar application of Nofatrein and Setrein on micronutrients content in garlic bulbs.

Characters / Treatments l/fad		Micronutrients (mg/ kg)					
		Fe		Mn		Zn	
		S1	S2	S1	S2	S1	S2
Nofatrien	0	23.21	24.60	15.51	16.50	16.41	17.37
	1.5	25.79	26.11	16.53	17.55	18.57	19.45
	3.0	27.65	27.78	17.54	18.57	20.45	20.47
	4.5	29.37	29.80	19.47	20.59	21.47	22.49
	Mean	26.51	27.07	17.26	18.30	15.70	19.95
Sterein	0	23.21	24.60	15.51	16.50	16.41	17.37
	1.5	26.41	26.75	18.55	19.57	19.46	20.47
	3.0	29.51	29.58	19.57	20.59	21.49	22.49
	4.5	31.32	32.94	21.60	22.63	22.52	23.54
	Mean	27.61	28.47	18.81	19.82	19.97	20.79
Mean of level	0.0	23.21	24.6	15.51	16.50	16.41	17.37
	1.5	26.1	26.43	17.54	18.56	18.97	19.96
	3.0	28.58	28.68	18.56	19.58	20.97	21.48
	4.5	30.35	31.37	20.34	21.61	22.00	23.02
$LSD_{0.05}$ type		0.013	0.041	0.013	n. s	n. s	n. s
$LSD_{0.05}$ level		0.040	0.040	0.018	0.040	0.013	0.016
$LSD_{0.05}$ inter		0.056	0.056	0.018	0.056	n. s	0.018

Data in Table 8 revealed that the garlic uptake of Fe, Mn and Zn in both seasons were increased significantly with increasing the Nofatarien and Setrein levels in comparison with control. Data clearly demonstrate that the application of Nofatrein and Setrein compounds at different rates to garlic obviously increased concentrations of Fe, Mn and Zn uptake especially at the rate of 4.5 l/fed (D and H treatment). This results were in line with Negm (2004) and Ranjabr & Bahmaniar (2007).

5. Quality of garlic bulb

The effect of foliar application of Nofatrein and Setrein on chemical constitutes of garlic at harvest time are obtained in Table 9. It is obvious that foliar application had a significant effect on all parameters in both seasons, the highest values were at D and H treatments compared with the control, on the other hand, increased rate of total carbohydrate (54.26 and 54.49 gm/100g D.M), total protein (14.62 and 14.79 gm/100g D.M) and volatile oil yield (8.51 and 8.60 l/fed) where confirmed by the means of these parameters for Nofatrein and Setrein respectively. These results are in agreement with those obtained by Abou-El-khair (2004) and El-Seifi *et al.* (2004) due to increase chemical content in garlic bulb. Also, similar results were obtained by Tien *et al.* (1979); Kamel *et al.* (1983); Bouten *et al.* (1985) and El-Haddad *et al.* (1993) who illustrated that

nutrient elements (P, Fe, Zn, Mn and K) were contributed with some phytohormones such as gibberellins and cytokinins and hence increase chemical contents in different plant tissues. Abou Hadid *et al.* (1998) also found that applied nutrient solution (N, P, K, Ca, Mg, S, Fe, B, Mn, Zn, Mn, Cu) to garlic plants increased clove weight, bulb weight, total yield and volatile oil yield.

TABLE 8. Effect of foliar application of Nofatrein and Setrein on micronutrients uptake in garlic bulbs.

Characters / Treatments		Micronutrient uptake (mg/plant)								
		Fe			Mn			Zn		
		S1	S2	Mean	S1	S2	Mean	S1	S2	Mean
Nofatrein	0	0.23	0.24	0.23	0.15	0.17	0.16	0.16	0.17	0.16
	1.5	0.26	0.27	0.27	0.17	0.18	0.17	0.19	0.20	0.19
	3.0	0.34	0.33	0.33	0.21	0.23	0.22	0.25	0.25	0.25
	4.5	0.39	0.40	0.39	0.25	0.27	0.26	0.28	0.30	0.29
	Mean	0.31	0.32	0.31	0.20	0.21	0.20	0.22	0.23	0.22
Setrein	0	0.23	0.24	0.23	0.15	0.17	0.16	0.16	0.17	0.16
	1.5	0.27	0.27	0.27	0.19	0.20	0.19	0.20	0.22	0.21
	3.0	0.36	0.37	0.33	0.26	0.26	0.26	0.27	0.28	0.27
	4.5	0.41	0.45	0.44	0.28	0.31	0.30	0.30	0.32	0.31
	Mean	0.31	0.32	0.32	0.22	0.24	0.23	0.23	0.25	0.24
Mean of level	0.0	0.23	0.24	0.23	0.15	0.17	0.16	0.16	0.17	0.16
	1.5	0.27	0.27	0.27	0.18	0.19	0.18	0.19	0.21	0.20
	3.0	0.35	0.35	0.32	0.23	0.25	0.24	0.26	0.27	0.26
	4.5	0.40	0.43	0.42	0.27	0.29	0.28	0.29	0.31	0.30
$LSD_{0.05}$ type		0.0001	0.001	0.013	0.0001	n. s	n. s	n. s	n. s	0.0130
$LSD_{0.05}$ level		0.001	0.001	0.040	0.0001	0.001	0.0126	0.0001	0.0001	0.003
$LSD_{0.05}$ inter		0.001	0.001	n. s	0.0001	0.001	n. s	n. s	0.0001	n. s

Concerning the accumulation of NO_3^{--} or NO_2^{--} in edible food represent a serious problems for human's health, because NO_3^{--} or NO_2^{--} absorbed into blood and may oxidize Fe^{++} of hemoglobin to Fe^{+++} and hence producing methemoglobin, which can not transport oxygen (Swann, 1975), therefore using of foliar spray nutrients which are free from harmons are very important to plant nutrition and also to prevent nitrate contents from exceeding over recommended limit according to Schütt (1977) and Corré & Preimer (1979) who mentioned that the standards for nitrate content of vegetables ranged from 600 to 1200 mg/kg fresh vegetable product.

In this context, data in Table 9 clarifed that nitrate content located between recommended limit in the previous mentioned where the values ranged from 1079 to 1112 mg/kg fresh weight.

TABLE 9. The bulb quality at harvest time of garlic plant influenced by foliar application of Nofatrein and Setrein.

Characters / Treatments L/fed		gm/100g (D.M)*						Nitrate mg/kg (F.W)**			Volatile oil yield (l/ fed)		
		Total carbohydrate			Total protein								
		S1	S2	Mean	S1	S2	Mean	S1	S2	Mean	S1	S2	Mean
Nofatrien	0	48.28	49.72	49.00	10.19	10.44	10.32	1079	1086	1082	5.31	5.64	5.48
	1.5	52.13	52.44	52.29	13.50	13.38	13.44	1086	1091	1088	7.46	7.65	7.56
	3.0	53.20	53.29	53.25	13.75	14.19	13.97	1095	1096	1096	7.78	7.88	7.83
	4.5	54.11	54.40	54.26	14.50	14.75	14.62	1108	1112	1110	8.45	8.54	8.51
	Mean	51.93	52.46	52.20	12.99	13.19	13.09	1092	1096	1094	7.25	7.43	7.34
Setrein	0	48.28	49.72	49.00	10.19	10.44	10.32	1079	1086	1083	5.31	5.64	5.48
	1.5	51.87	52.36	52.12	13.38	13.56	13.47	1080	1083	1082	7.39	7.61	7.50
	3.0	53.30	53.30	53.30	14.06	14.25	14.16	1086	1087	1087	7.82	7.90	7.86
	4.5	54.21	54.76	54.49	14.64	14.94	14.79	1097	1104	1101	8.51	8.65	8.60
	Mean	51.92	52.54	52.23	13.07	13.30	13.19	1085	1090	1088	7.26	7.45	7.63
Mean of level	0.0	48.28	49.72	49.00	10.19	10.44	10.32	1079	1086	1082	5.31	5.64	5.48
	1.5	52.00	52.40	52.21	13.44	13.49	13.35	1083	1087	1085	7.43	7.63	7.53
	3.0	53.25	53.30	53.28	13.91	14.85	14.22	1090	1091	1092	7.80	7.89	7.85
	4.5	54.16	54.53	54.38	14.57	14.62	14.60	1102	1108	1105	8.48	8.60	8.55
$LSD_{0.05}$ type		n. s	n. s	n. s	n. s	n. s	n. s	3.78	0.96	n. s	n. s	n. s	n. s
$LSD_{0.05}$ level		0.1378	0.1319	0.07	0.18	0.06	0.04	5.02	0.93	n. s	0.06	0.040	0.04
$LSD_{0.05}$ inter		0.1949	n. s	0.01	0.26	n. s	0.06	n. s	1.31	n. s	n. s	0.056	0.06

* dry matter. ** fresh weight.

6. Weight loss per cent

Data in Table 10 elevated that percentage of total weight loss of garlic bulb (Balady cultivar) significantly increased throughout storage period for ten months in both seasons. Data illustrated that increasing the storage period from 30 to 300 days constantly reduced stored garlic bulb weights in both seasons. In this respect, Zaki (1984) found that the percentage of total weight loss throughout storage period was higher in Chinese. Than American and Balady cultivars. A side from observed that the greatest weight loss in both seasons recorded with treatments at 4.5 l/fed (D and H treatments) indicating that the increasing of weight loss of bulb in all treatments during storage period was a positive correlation (r = 0.98**) with the increasing of average (Table 4).

These results might be due to cell sap water loss through evaporation and dry mater loss through high respiration and loss of high moisture content and emaciation and finally weight loss in the stored bulbs. These results are in agreement with those reported by Osman *et al.* (1996); El-Mansi *et al.* (1999); El-Seifi *et al.* (2004) and Abou El-Khair (2004).

TABLE 10. Weight loss percentage after ten months.

Characters / Treatments	l/fed	Weight loss percentage									
		30 days	60 days	90 days	120 days	150 days	180 days	210 days	240 days	270 days	300 days
		Season 1									
Nofatrien	0.0	6.52	7.64	8.37	10.18	11.56	13.61	15.81	17.36	20.53	23.31
	1.5	7.84	8.43	9.72	11.29	13.95	14.57	17.36	19.45	21.19	24.23
	3.0	7.95	8.75	9.87	11.41	14.10	14.63	17.51	19.60	22.33	26.58
	4.5	8.11	9.10	9.95	11.56	14.27	14.74	17.64	19.71	25.55	29.17
Starein	0.0	6.52	7.64	8.37	10.18	11.56	13.61	15.81	17.36	20.53	23.31
	1.5	7.61	8.25	9.53	11.10	13.75	14.32	17.24	19.28	20.31	23.16
	3.0	7.72	8.58	9.64	11.25	13.92	14.45	17.41	19.43	22.11	25.47
	4.5	8.26	9.25	10.10	11.63	14.31	14.83	17.78	19.82	26.17	33.18
$LSD_{0.05}$ type		n. s	n. s	0.02	n. s	0.07	n. s	n. s	n. s	n. s	0.16
$LSD_{0.05}$ level		0.43	0.04	0.16	0.97	0.18	0.97	0.17	0.23	0.39	0.08
$LSD_{0.05}$ inter		n. s	0.06	n. s	n. s	n. s	n. s	n. s	n. s	0.54	0.11
		Season 2									
Nofetrien	0.0	6.75	7.85	8.64	10.29	11.75	13.80	15.91	18.10	20.77	23.80
	1.5	8.33	9.16	10.26	11.54	14.15	14.40	17.39	19.40	21.63	25.71
	3.0	8.47	9.12	10.53	11.67	14.33	14.53	17.60	19.53	24.56	28.91
	4.5	8.34	9.31	10.64	11.71	14.50	14.92	17.81	19.97	26.97	33.88
Sterein	0.0	6.75	7.85	8.64	10.29	11.75	13.80	15.91	18.10	20.77	23.80
	1.5	8.11	9.10	10.11	11.36	14.10	14.27	17.18	19.27	21.47	24.16
	3.0	8.25	9.11	10.24	11.51	14.12	14.32	17.46	19.36	24.35	27.15
	4.5	8.65	9.46	10.72	11.83	14.60	15.10	17.90	20.11	27.81	34.02
$LSD_{0.05}$ type		0.021	n. s	n. s	n. s	n. s	n. s	n. s	n. s	0.01	0.19
$LSD_{0.05}$ level		0.07	0 10	0.04	0.06	0.06	0.06	0.07	0.19	0.07	0.04
$LSD_{0.05}$ inter		0.10	n. s	0.06	0.08	0.08	0.08	0.10	n. s	0.10	0.06

Conclusion

It could be concluded that foliar application of Nofatrein or Setrein (commercial product) as organic plant nutritive compounds which product and recommended by General Organization for Agricultural Equalization Fund (GOAEF), Ministry of Agriculture to garlic plant in alkaline soil with mineral fertilizers (60 kg/fed N, 30 kg/fed P_2O_5 and 45 kg/fed K_2O) led to significantly increased total yield, its components and its quality than un-sprayed treatments and the highest values were found at the rate of 4.5 l/fed for both Nofatrien and Setrein.

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تأثير إضافة المركبات المغذية رشاً على إنتاجية ومكونات محصول الثوم فى أرض قلوية

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أجريت تجربتان حقليتان خلال موسمى ٢٠٠٦/٢٠٠٥ ، ٢٠٠٧/٢٠٠٦ بمزرعة خاصة – مركز دير نجم – محافظة الشرقية بهدف دراسة تأثير إضافة مغذيي النبات النوفترين والسترين رشاً بمعدلات صفر ، ١,٥ ، ٣ ، ٤,٥ لتر/ فدان على إنتاجية محصول الثوم (صنف بلدى) وصفاته ومكوناته ومحتواه الكيميائى وكذلك الفقد فى الوزن أثناء فترة التخزين .

ويمكن تلخيص النتائج المتحصل عليها فيما يلى :

١. أدت إضافة كل من النوفترين والسترين بالمعدلات المختلفة إلى الزيادة المعنوية مقارنة بالكنترول (الغير معاملة رشاً) فى كل من الإنتاج الكلى والتصديرى والتسويقى للمحصول (طن/ فدان) ومتوسط وزن البصلة والمادة الجافة والنسبة المئوية للإستجابة وكذلك محتوى الأبصال والممتص من النيتروجين والفوسفور والبوتاسيوم وكذلك محتوى الأبصال والممتص من العناصر الصغرى والزيت الطيار فى الأبصال (لتر/فدان).

٢. عموماً كانت أحسن النتائج لكل الصفات المدروسة مع إضافة ٤,٥ لتر/فدان لكل من النوفترين والسترين مقارنة بالكنترول.

٣.أدت إضافة ٤,٥ لتر فدان من النوفترين والسترين إلى الزيادة المعنوية فى الإنتاج الكلى للمحصول فى الموسمين. ففى الموسم الأول بلغ معدل الإنتاج الكلى ٩,٧، ٩,٩٢ طن/فدن مع النوفترين والسترين على التوالى بينما فى الموسم الثانى بلغ الإنتاج الكلى ١٠,٠٨، ١٠,٢٩ طن /فدان مع النوفترين والسترين على التوالى .

٤.أدت إضافة ٤,٥ لتر/فدان من مركب النوفترين او السترين إلى تحقيق أعلى استجابة لمحصول الثوم مقارنة بالكنترول.

٥. كانت الزيادة معنوية بالنسبة لمحتوى الأبصال من الكربوهيدات الكلية والبروتين الكلى فى هاتين المعاملتين.

٦.كانت كمية النترات فى جميع المعاملات فى الحدود الآمنة والمسموح بها .

٧.كانت هناك زيادة معنوية فى كمية الزيت الطيار(لتر/ فدان) مع معاملات النوفترين والسترين وخصوصاً المعاملة ٤,٥ لتر/ فدان مقارنة بالكنترول.

٨.أدت زيادة معدلات الإضافة للنوفترين أوالسترين إلى زيادة النسبة المئوية للفقد فى الوزن أثناء فترة التخزين والتى كانت متناسبة طردياً مع متوسط وزن البصلة.

٩. وجد أن أحسن المعاملات لإنتاج محصول الثوم تحت الظروف القلوية للأرض موضوع الدراسة هو إضافة ٤,٥ لتر/ فدان رشاً (على ثلاث دفعات متساوية) من أى من هذين المغذيين لاحتوائهما على عناصر صغرى أو عناصر صغرى وكبرى معاً.