Current Science International, 3(1): 1-6, 2014
ISSN: 2077-4435

Foliar Application of Some Plant Nutritive Compounds on Growth, Yield and Fruit Quality of Hot Pepper Plants (*Capsicum annum*, L.) Grown Under Plastic House Conditions.

Shafeek, M.R., Y.I. Helmy, Awatef, G. Beheiry, Fatma A. Rizk and Nadia M. Omar

Vegetables Crop Research Dept., National Research Centre, Dokki, Cairo, Egypt.

ABSTRACT

Two field experiments were carried out during two experimental seasons of 2010/2011 and 2011/2012 under newly sandy reclaimed soil at El-Nubaria region. The aim of these experiments is to study the vegetative growth, total yield and chemical parameters of hot pepper cv. Benisweif Hybrid F1 as influenced by sources of minor nutrient foliar application (Greenzit or Novatren) with 5 levels of nutrient foliar application (0, 1, 1.5, 3 and 4.5 L/fed) as foliar spraying for three times in 15 days interval. The obtained results strongly indicated that the vigor plant growth expressed as number of leaves/plant and net assimilation rate (NAR) and the highest total fruits yield and its components as well as the high content of the percentage of N, K and protein of hot pepper fruits tissues were detected with that plants which sprayed as minor nutritional Greenzit compared Novatren at the same concentration. In the same regards, foliar spraying of plants by both minor nutritional fertilizers at level of 3 L/fed gained the best plant growth and yield if compared with the other application levels. Also, the mineral contents of fruit tissues followed the same trends of results. However, with increasing nutrition application level spraying significantly decreased vitamin C content in fruit tissues compared to control treatment. On the other hand, at highest level (4.5 L/fed) resulted less vigor of plant growth, yield and its fruit quality if compared with that plants which treated with minor nutritional fertilizer at (3L/fed).

Key words: hot pepper, growth, fruit yield and quality, nutrition application.

Introduction

Hot pepper is excellent source of antioxidant compounds and natural colors, like carotenoids and vitamin C Shao *et al* (2008). It is an important agronomic crop which rich in antioxidants, vitamin C, pro-vitamin A, E, P (citrin), B_1 (thiamine), B_2 (riboflavin), and B_3 (niacin).

In addition, now more than other times vegetable plants needs not only N, P and K but also for other mineral nutrients, such as Fe, Mn and Zn. Now in Egypt, there are many foliar fertilizers containing the most macro and micro elements usually used to correct any defect in soil. 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) and Hassan *et al* (2011) reported that, spraying with both Fe and Zn in different forms and rates gave significantly increases in total yield and Fe, Zn and K uptake of deferent plants. The mechanism role of these nutrients in metabolism processes were studied by many authors such as (Tamilselvi *et al.* 2002; Hatwar *et al.* 2003, Shaheen *et al* ,2007-a. and Savitha 2008) they showed that, the application of some minerals as foliar spray caused an enhancement in plant growth, fruit yield and its physical and chemical properties of fruits. In the same respect, Bhatt *et al.* (2004) studied the effect of foliar application of micronutrients on yield and economics of tomato. They reported that foliar application of Fe SO_4 at 0.01 per cent resulted in significant improvement in yield per ha which might be attributed to increased photosynthetic activity and increased production and accumulation of carbohydrate. Also, Malawadi *et al.* (2004) studied the effect of soil application of micronutrients on yield and quality of chilli they observed that, application of iron in the form of iron chloride at 12 kg per ha recorded higher fruit weight (198.1 g), yield (843.86 kg/ha) and recorded maximum ascorbic acid (81.67 mg/100 g) content of pepper fruits. Also, Batra *et al.* (2006) and Savitha (2008) reported that, foliar application of iron in the form of iron sulphate 5g / L at 40, 50 and 60 days after transplanting resulted in significant improvement in ascorbic acid content (25.29 mg/100 g) in tomato fruits. The most probable reason for increased Vitamin C content might be due to increase in the activity of ascorbic acid oxidize enzyme causing the marked improvement in Vitamin-C content. Tamilselvi *et al.* (2002) observed maximum TSS, acidity, ascorbic acid and lycopene contents with the application of micronutrients. Due to Greenzit and Nofatrein pamphlets, foliar application of them has a very important environmental goal as it minimizes pollution of soil with mineral fertilizers and hence reducing its mobility to under ground water or surface water.

Corresponding Author: Shafeek, M.R., Vegetables Crop Research Dept., National Research Centre, Dokki, Cairo, Egypt.

Thus, the aim of this work was to study that effect of some sources and concentrations of plant nutritive compounds containing micronutrients at four rates on bell pepper plant growth, yield and quality under plastic house conditions.

Material and Methods

Two experiments in plastic house were conducted at Experimental Station of National Research Centre at Nubaria region, North Egypt in 2011 and 2012. The experimental site had a sandy soil texture with pH of 7.6, Ec of 0.19 and the organic matter was 0.21% with 14.00, 8.90 and 15.60 mg/100g soil of N, P and K respectively. Hot pepper seedlings (*Capsicum annuum* L.) cv Benisweif Hybrid F1 was obtained from a local commercial nursery. Healthy seedlings of uniform size were selected and transplanted on October 7, 2011 and 2012 seasons respectively. Full dose of P_2O_5 (90 kg/fed.) as single super phosphate (15%P_2O_5) and half dose of K_2O (60 kg/fed.) as potassium sulfate (50% K_2O) plus compost (5 ton/fed.) were added at soil preparation and the mixture were then incorporated into the top 15 cm of the ridge soil. While remaining K dose was applied 45 days after transplanting. Chemical fertilizers including mineral N were added through the fertigation system. A drip irrigation system was designed for the experiment. Regular standard agricultural practices common in the area as recommended by Egyptian Ministry of Agriculture were followed. In this work the different foliar application rates from Greenzit and Nofatrein to hot pepper were conducted according to the classification of **U.S.** Salinity Laboratory Staff (1954) and FAO (1988). Foliar application of the deferent levels of plant nutritive compounds was equally added after 4, 8 and 12 weeks from transplanting.

Table 1: The Chemical composition of Greenzit and Nofatrein compound.

Contents	Greenzit	Nofatrein
A. Macro elements:		
N %	7	5
P %	3	5
K %	3.9	5
Mg %	0.01	-
B. Micro elements:		
Fe ppm	1000	1500
Mn ppm	100	50
Zn ppm	50	50
Cu ppm	10	50
Mo ppm	5	5
B ppm	100	50

A split-plot design with three replicates was used the main blot treatments were two sources of plant nutritive compounds Greenzit or Nofatrein and the rates represent the main sub blot treatments. This experiment included 10 treatments which included all combinations between the two source of nutritive compounds Greenzit or Nofatrien with five concentrations (0, 1.0, 1.5, 3 and 4.5 L/fed.). Each experimental plot area under plastic house was 20 m^2 (four ridges each was 1m in width and 5m in length). At the vegetative growth stage, random samples of five plants from each plot were taken 45 days from transplanting for determination of plant length (cm), number of branches and leaves per plant as well as green leaf area (LA cm^2) by an electronic area meter (Model 3100; Li-Cor, Lincoln, NE, USA).and Net Assimilation Rate (NAR mg/cm^2/day) were determined on the leaves No.4 from the plant top using a digital leaf area meter was calculated according to Watson (1958). At harvesting time (60 days from transplanting) pepper fruits were picked weekly through the harvesting period for estimation of yield parameters, i.e. number and weight of fruits per plant, total yield per m^2. For fruit quality determination a random sample of 20 fruits from each plots were taken and the average fruit weight, fruit length and diameter were recorded and also chemical properties of fruit i.e. N, P and K were determined according to Black (1983), Watanab and Olsen (1965) and Jackson (1965)**,** respectively. However, ascorbic acid was determined according to AOAC (1975). In addition, protein percentages in fruit were calculated by multiplying nitrogen content by 6.25. The obtained data of experiments were subjected to the statistically analysis of variance procedure and means were compared using the LSD method at 5% level of significance according to Gome and Gomez (1984).

Results and Discussion

Vegetative growth characters:

Table (2) showed the effect of source and nutritive compounds concentration on growth characters of hot pepper plants during 2011 and 2012 seasons under plastic house condition. Data show that growth characters response of hot pepper plants varied in its responses to nutritive compounds and concentration. Where the effect of plant nutritive compounds source was not significant except on number of leaves plant and net assimilation rate (NAR) in both seasons. Data observed that plant nutritive Greenzit significantly increased number of leaves plant and net assimilation rate (NAR) in both seasons compared plant nutritive Nofatrein. Such enhancement effect might be attributed to the favorable influence of Greenzit on photosynthesis process, metabolism and biological activity which in turn encourage vegetative growth of plants. Also, the superiority of plant nutritive Greenzit in enhancing plant growth characters may be attributed to its high content of microelements especially boron and manganese than Nofatrein compounds (Table1), which effect the metabolic processes and in turn enhanced plant growth. In addition, Anderson and Pyliotis (1969) reported that, spraying plants of boric acid increased both chlorophyll content and stability of chlorophyll protein-Lipid complex in the leaves. Moreover, Mn activates number of enzymes involved in carbohydrate metabolism and also is essential in the photosynthetic apparatus were found.

The plant growth characters of hot pepper plant was progressively increased with increasing the concentration of two nutrition fertilizer, so spraying the foliage with all the concentrations compared to control. However, high concentration of nutritive compound (3L/fed) statistically induced the highest plant growth characters at 60 days after transplanting as compared with all rates of compound foliar fertilizer and control in both seasons. From other side, the obtained data reveals that the hot pepper plants which sprayed with two plant nutritive compound at highest level (4.5 L/fed) resulted less vigor of plant growth characters if compared with that plants which treated with two plant nutritive compounds at (3L/fed). Moreover, foliar application of highest level of nutrients compound could improve the nutrient utilization and lower environmental pollution through reducing the amounts of fertilizers added to soil Abou-El-Nour (2002).

The interaction between plant nutrition compounds source and rates during the two experimental seasons had no significant effect on all plant growth parameters. However, as foliar application of nutrition Greenzit at 3L/fed achieved the highest plant growth characters records. The obtained results are in good accordance with these which obtained by (Fatma and Shafeek 2000, El-Abagy 2003, Hatwar *et al.* 2003, Shaheen *et al* 2007-a. and Savitha 2008).

Total fruits yield:

Data presented in Table (3) shows that spray of plant nutrient Greenzit significantly increased total fruits yield per plant and total fruits yield per m^2 compared nutrient Nofatrein. On the other hand, number of fruits/plant was not affected. These results are good in both seasons. This means that both yield and vegetative growth were affected by the same degree by foliar spray with the different used nutrient compounds. Similar findings were obtained by Fatma and Shafeek 2000, El-Abagy 2003 and Savitha 2008). They indicated that the superiority of some plant nutritive compound than other compounds might be attributed to its rich in macro elements especially P, K, S, Ca and Mg or might be due to its intermediate content of micro elements or due to its additional materials such as amino acid, hormones and or vitamins.

Table (3) shows clearly that all concentrations of two plant nutrient compounds Greenzit or Nofatrein significantly increased total fruits yield i.e. number of fruits/plant, weight of fruits/plant (g) and weight of fruits/m^2 (kg) compared control in both two experimental seasons. Whereas, foliar application of two plant nutrient compounds at level of 3L/fed resulted the heaviest total fruits yield per m^2 (1.956 kg and 1.622 kg in 1^{st} and 2^{nd} seasons, respectively). However, number of fruits/plant, weight of fruits/plant (g) and weight of fruits/m^2 (kg) of hot pepper decreased when the foliar application of highest rate of both two nutritive compounds (4.5 L/fed.) these were true in both seasons. These results are apparently due to the role of the micronutrients and the other macro elements in the nutrient compounds affecting the metabolic process and in turn in plant growth. Foliar application of micronutrients seems to stimulate the metabolic process within the plant through their direct effect on the enzymatic reactions (Peyve 1969). It could be summarized that nutritive compounds caused an increment in total fruits yield if treated at rate of 3L/fed. the trend of these results are supported by that of Malawadi *et al.* (2004) and Savitha (2008) on hot pepper and Tamilselvi, *et al* (2002) and Bhatt *et al.* (2004) on tomato.

The interaction between plant nutrition compounds source and rates during the two experimental seasons had no significant effect on total fruits yield and its components. However, as foliar application of nutrition Greenzit at 3L/fed achieved the highest total yield of fruits records.

Physical and chemical fruit characters:

The effect of nutrition sources on physical and chemical constituents of hot pepper fruits were presented in Table (4 and 5). However, all the physical fruit characters of hot pepper fruits i.e. (average weight of fruit, fruit length and diameter) had no significant effect in both seasons (Table4). On the other hand, the chemical constituents of fruits were significantly increased in N%, Protein % and K % by foliar application of Greenzit compared Nofatrein (Table5). This observation was completely true in both seasons. Similar results were obtained by Fatma and Shafeek (2000) and El-Abagy (2003).

In addition, the effect of nutrient concentrations on the physical fruit characters of hot pepper was no significant effect in both seasons (Table 4). Moreover, the effect of nutrient concentrations on the chemical constituents of hot pepper fruits (Table5). It is worthy that, with increasing nutrition application level spraying up to 3L/fed caused an enhancement in the nutritional value of fruit tissues expressed as (the percentage of nitrogen, protein and potassium). It means that foliar application of 3L/fed result more nutritional values if compared with the other levels and control treatment. Moreover, hot pepper plants which sprayed by 4.5 L/fed of nutrition application gained decreasing nutritional values on fruit tissues. On the other hand, with increasing nutrition application level spraying significantly decreased vitamin C content in fruit tissues compared to control treatment. These findings are completely similar in both seasons. The obtained results are in good accordance with that reported by Fatma and Shafeek (2000), Malawadi *et al.* (2004) and Savitha (2008) on hot pepper and Tamilselvi, *et al* (2002) and Bhatt *et al.* (2004) on tomato.

Regarding the effect of the interaction between nutrient sources and concentrations the effect was not significant of the physical and chemical constituent of hot pepper fruits compared to control treatment

Table 2: Effect of interaction between sources and levels of plant nutritive compounds on growth characters of hot pepper during 2011 and 2012 seasons.

Sources	Levels (L/fed.)	Plant length (cm)		Number of plant Leaves		Number of plant Branches		LA cm^2		NAR mg /cm^2/ day	
		2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
Nofatrein	0	58.31	61.52	80.59	78.00	6.51	6.18	51.18	49.81	16.21	15.54
	1.0	62.55	66.22	88.90	88.90	7.29	6.93	53.06	51.20	18.07	17.06
	1.5	65.24	67.38	89.63	89.63	7.54	7.00	61.34	58.27	18.70	18.04
	3.0	68.03	69.03	90.2	91.38	7.78	7.62	78.97	67.35	20.27	19.71
	4.5	61.18	61.84	89.12	88.47	7.24	6.91	75.33	65.23	19.63	17.89
Mean		**63.06**	**65.20**	**87.83**	**87.28**	**7.27**	**6.93**	**63.98**	**58.37**	**18.86**	**17.65**
Setrein	0	58.31	61.52	80.59	78.00	6.51	6.18	51.18	49.81	16.21	15.54
	1.0	63.63	66.97	86.05	86.68	6.85	6.55	57.00	54.67	17.22	16.60
	1.5	65.78	67.78	88.41	88.41	6.37	6.03	66.17	60.50	17.27	16.70
	3.0	68.36	68.88	88.53	88.34	6.92	6.02	73.88	70.63	17.80	17.45
	4.5	60.60	64.35	82.63	84.19	6.91	6.98	71.11	69.30	17.41	16.88
Mean		**63.33**	**65.89**	**85.24**	**85.12**	**6.71**	**6.35**	**63.87**	**60.98**	**17.18**	**16.64**
Mean of levels	0	58.31	61.52	80.59	78.00	6.51	6.18	51.18	49.81	16.21	15.54
	1.0	63.09	66.60	87.48	87.79	7.07	6.74	55.03	52.94	17.65	16.83
	1.5	65.51	67.58	89.02	89.02	6.96	6.52	63.76	59.38	17.99	17.37
	3.0	68.20	68.96	89.72	89.86	7.35	6.82	76.42	68.99	19.04	18.58
	4.5	60.89	63.10	85.87	86.33	7.08	6.95	73.22	67.27	18.52	17.39
LSD at 5%	Sources	**NS**	**NS**	**2.56**	**1.52**	**NS**	**NS**	**NS**	**NS**	**0.49**	**0.56**
	Levels	**1.77**	**2.23**	**2.59**	**1.94**	**NS**	**NS**	**4.06**	**6.15**	**1.44**	**1.49**
	Inter.	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

LA cm^2 = green leaf area. NAR = Net Assimilation Rate mg /cm^2/ day.

Table 3: Effect of interaction between sources and levels of plant nutritive compounds on total yield of hot pepper during 2011 and 2012 seasons.

Sources	Levels (L/fed.)	Number of fruits / plant		Total yield / plant (g)		Total yield /m^2 (kg)	
		2011	2012	2011	2012	2011	2012
Nofatrein	0	57.37	58.63	430.87	363.87	1.721	1.415
	1.0	68.94	65.61	481.81	415.13	1.925	1.592
	1.5	71.27	67.83	496.10	429.43	1.983	1.6493
	3.0	73.10	71.23	517.90	451.31	2.110	1.773
	4.5	71.79	69.41	490.15	423.46	1.964	1.630
Mean		**68.49**	**66.54**	**483.37**	**416.64**	**1.940**	**1.612**
Setrein	0	57.37	58.63	430.87	363.87	1.721	1.415
	1.0	65.09	61.94	473.57	406.78	1.821	1.508
	1.5	69.15	65.82	476.13	409.35	1.827	1.493
	3.0	68.46	67.89	496.14	429.34	1.806	1.471
	4.5	67.56	64.78	485.53	419.04	1.863	1.536
Mean		**64.92**	**63.81**	**472.45**	**405.68**	**1.808**	**1.485**
Mean of levels	0	57.37	58.63	430.87	363.87	1.721	1.415
	1.0	67.02	63.77	477.69	410.95	1.873	1.550
	1.5	68.69	66.82	486.11	419.39	1.905	1.571
	3.0	70.78	69.56	507.02	440.33	1.956	1.622
	4.5	69.67	67.10	487.84	421.25	1.914	1.584
LSD at 5%	**Sources**	**NS**	**NS**	**10.62**	**10.73**	**0.12**	**0.12**
	Levels	**2.94**	**4.76**	**21.45**	**21.55**	**0.10**	**0.12**
	Inter.	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Table 4: Effect of interaction between sources and levels of plant nutritive compounds on physical fruit quality of hot pepper during 2011 and 2012 seasons.

Sources	Levels (L/fed.)	Average weight of fruit (g)		Fruit length (cm)		Fruit diameter (cm)	
		2011	2012	2011	2012	2011	2012
Nofatrein	0	6.11	5.78	13.71	13.38	1.31	1.24
	1.0	6.26	5.93	13.97	13.64	1.29	1.21
	1.5	6.33	6.00	14.52	13.85	1.35	1.28
	3.0	6.48	6.15	14.21	13.87	1.37	1.31
	4.5	6.60	6.25	14.22	13.88	1.63	1.30
Mean		**6.36**	**6.02**	**14.13**	**13.72**	**1.33**	**1.27**
Setrein	0	6.11	5.78	13.71	13.38	1.31	1.24
	1.0	6.00	5.66	13.86	13.52	1.31	1.24
	1.5	6.20	5.86	14.18	13.51	1.36	1.3
	3.0	6.48	6.18	14.52	13.78	1.36	1.29
	4.5	6.26	5.93	14.35	13.68	1.33	1.26
Mean		**6.21**	**5.88**	**14.12**	**13.57**	**1.33**	**1.27**
Mean of levels	0	6.11	5.78	13.71	13.38	1.31	1.24
	1.0	6.13	5.80	13.91	13.58	1.29	1.23
	1.5	6.27	5.93	14.35	13.68	1.36	1.29
	3.0	6.48	6.17	14.36	13.83	1.37	1.30
	4.5	6.43	6.09	14.28	13.78	1.35	1.28
LSD at 5%	Sources	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
	Levels	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
	Inter.	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Table 5: Effect of interaction between sources and levels of plant nutritive compounds on chemical fruit quality of hot pepper during 2011 and 2012 seasons.

Sources	Levels (L/fed.)	%								mg/100 g FW	
		N		Protein		P		K		Vitamin C	
		2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
Nofatrein	0	3.32	2.98	20.73	18.65	0.82	0.73	1.78	1.74	91.92	76.08
	1.0	3.35	3.02	20.94	18.85	0.80	0.67	1.94	2.01	83.95	69.93
	1.5	3.47	3.14	21.69	19.60	0.80	0.68	2.08	2.08	72.04	59.57
	3.0	3.53	3.19	22.04	19.96	0.75	0.67	2.09	2.12	65.49	58.68
	4.5	3.50	3.17	21.90	19.81	0.68	0.61	1.78	1.99	52.38	48.83
Mean		**3.43**	**3.10**	**21.46**	**19.38**	**0.77**	**0.67**	**2.05**	**1.99**	**73.16**	**62.62**
Setrein	0	3.32	2.98	20.73	18.65	0.82	0.73	1.78	1.74	91.92	76.08
	1.0	3.36	3.02	20.98	18.90	0.75	0.68	2.04	1.91	67.08	60.50
	1.5	3.38	3.05	21.13	19.05	0.70	0.65	2.11	1.92	62.83	58.83
	3.0	3.37	3.03	21.04	18.96	0.81	0.62	2.03	1.95	56.43	49.88
	4.5	3.35	3.02	20.96	18.88	0.75	0.68	2.08	1.96	46.62	43.06
Mean		**3.35**	**3.02**	**20.97**	**18.88**	**0.76**	**0.67**	**2.01**	**1.90**	**64.90**	**57.67**
Mean of levels	0	3.32	2.98	20.73	18.65	0.82	0.73	1.78	1.74	91.92	76.08
	1.0	3.35	3.02	20.69	18.88	0.78	0.67	1.99	1.96	75.52	65.21
	1.5	3.43	3.09	21.41	19.33	0.75	0.66	2.09	1.10	67.44	59.20
	3.0	3.45	3.11	21.54	19.45	0.78	0.65	2.21	2.04	60.96	54.28
	4.5	3.43	3.10	21.43	19.35	0.72	0.65	2.08	1.97	49.32	45.95
LSD at 5%	Sources	**0.04**	**0.04**	**0.27**	**0.28**	**NS**	**NS**	**0.03**	**0.06**	**NS**	**NS**
	Levels	**0.08**	**0.08**	**0.49**	**0.50**	**NS**	**NS**	**0.18**	**0.17**	**8.97**	**10.99**
	Inter.	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

REFERENCES

Abou-El-Nour, E.A.A., 2002. Can supplemented potassium foliar feeding reduce the recommended soilpotassium? Pak. J. Biol. Sci., 5(3): 259-262.

Anderson, J.M. and N.A. Pyliotis, 1969. Studies with manganese deficient chloroplasts. Bio. Biophs. Acta, 189: 280-282.

AOAC., 1975. Association Agricultural Chemist, Washington, D.C., 200. Official Method of Analysis 12 th Edn., 44: 94-117.

Batra, V.K., M. Kamboj, S.K. Arora and R.S. Mange, 2006. Effect of foliar application of micronutrients on the quality and shelf-life of tomato. Haryana J. Hort. Sci., 35(1&2): 140-142.

Bhatt, L., B.K. Srivastava and M.P. Singh, 2004. Studies on the effect of foliar application of micronutrients on growth, yield and economics of tomato. Prog. Hort., 36(2): 331-334.

Black, C.A., 1983. Methods of Soil Analysis. Parts 1 and ll Am. Soc. Agron. Inc. Publ., Madison, Wisconsin, USA.

El-Abagy, H.M.H. and M.A. Ahmed, 2003. Effect of bio-and mineral phosphorus fertilizer on the growth, productivity and nutritional value of some faba bean (*Vicia faba* L.*)* cultivars in newly cultivated land. J. of Appli. Sci. Res., pp: 408-420.

FAO, 1988. Food and Agriculture Organization. Salt affected Soils and their management, FAO Soils Bulletin 39 Rome, Italy.

Fatma, A.R. and M.R. Shafeek, 2000. Response of growth and yield of vicia faba plants to foliar and bio-fertilizers. Egypt. J. Appl. Sci., 15(12): 652-670.

Gomez, K.A. and A.A. Gomez, 1984. Statistical procedures for Agriculture Research. Second Ed. Wiely Interscience Publ. John Willey and Sons, New York.

Hassan, M.A., M.A. El-Tohamy and A.A. Mohamed, 2011. Response of garlic cultivation in alkaline soil to foliar application of some plant nutritive compounds. Egypt. J. of Appli Sci., 26(5): 102-117.

Hatwar, G.P., S.U. Gondane, S.M. Urkude and O.V. Gahukar, 2003. Effect of micronutrients on growth and yield of chilli. J. Soils and Crops, 13(1): 123-125.

Hegab, A.A., M.A. Mahgoub and A.E. Youssef, 1987. Effect of iron, manganese and zinc on yield, cotton grade and quality of fiber properties of cotton. A gric. Res. Rev., 65: 645-657.

Jackson, M.L., 1965. Soil chemical analysis advanced course. Wisconsin, USA.

Malawadi, M.N., G.B. Shashidhara and Y.B. Palled, 2004. Effect of secondary and micronutrients on yield, nutrient uptake and quality of chilli. Karnataka J. Agric. Sci., 17(3): 553-556.

Negm, M.A., R.N. Zaki and A.L. El-Meneasy, 2004. Effect of iron and zinc as foliar application on sorghum grown in a calcareouse soil. Egypt. J. Soil. Sci., 44: 465-475.

Peyve, I.B.J., 1969. Participation of micro elements in biochemical orocess in connection with biosyntheses of protein in plants. Agrokimia, U.S.S.R., 2: 143.

Savitha, H.R., 2008. Effect of iron on yield and quality of red chilli (*capcicum annum* L.) in a calcareous vertisol of Zone-8 of Karnataka. M.Sc. Soil Sci. and Agri. Chem. Univ. of Agri. Sci.

Shahean, A.M., A.R. Fatma and S.M. Singer, 2007a. Growing onion plants without chemical fertilization. Research J. of Agri. And Biolo. Sci., 3(2): 95-104.

Shao, G.C., Z.Y. Zhang and N. Liu, 2008. Ccomparative effect of deficit irrigation and partialrootzone drying on soil water distribution, water use, growth and yield in greenhouse grown hot pepper. Sci. Hortic., 119: 11-16.

Tamilselvi, P., R.M. Vijayakumar and P. Nainar, 2002. Studies on the effect of foliar application of micronutrients on growth and yield of tomato (*Lycopersicon esculentum* Mill). Cv. PKM-1. South Ind. Hort., 53(1-6): 46-51.

Staff, 1954. Diagnosis and Improvement of Saline and Alkaline Soil. USDA, Agric., Handbook No. 60 US Gov., Printing Office Washington, USA.

Watanab, F.S. and S.R. Olsen, 1965. Test of an ascorbic acid method for determining phosphorus and Na HCO3 extracts for soil. Soil Sci. Soc. Am. Proc., 29: 677-678.

Watson, D.J., 1958. The dependence of net assimilation rate on leaf area index. Ann. Botany, 37-45.