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The Effects of Foliar Application of Urea, Calcium Nitrate and Boric Acid on Growth and Yield of Greenhouse Cucumber (cv. Khassib)

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ABSTRACT: The present study aimed to evaluate the effect of foliar application on greenhouse cucumber (cv. Khassib) in a five-month period (from March 2007 to July 2008) in Karaj city, Iran. To achieve the yield and high quality products, foliar application in greenhouses vegetables seems necessary. For this reason the experiment was conducted based on split-split-plot design with three replications. The effects of urea fertilizer concentration (3 g/L), calcium nitrate concentration (10 g/L) and boric acid concentration (0.5 g/L) on quality and quantity of greenhouse cucumber, including fruit yield, yield of grade 1 fruit, number of fruit, percentage of grade 1 fruit, plant length, percentage of leaf dray matter, and leaf weight ratio (LWR) were studied. Results indicated that among the main effects, treatment calcium nitrate had the most influence on the large number of traits. Also, among two-way interactions, treatment U1B1induced the most effect on yield of grade 1 fruit as well as for three-way interaction, only treatment U1C0B0 induced the most influence on the yield of total fruit, yield of grade 1 fruit and number of fruit.

Keywords: Greenhouse cucumber, Foliar nutrition, Urea, Calcium nitrate, Boric acid.

INTRODUCTION

Cucumis sativus L. is one of the most important and consuming vegetables, fourth one, after cucurbits, tomatoes, onions and cabbage (Crosby, 2008.). Cucumber is the second crop, after watermelon, of cucurbit family that is widely cultivated in the Middle East. Four countries including China, Iran, Turkey and the U.S. currently have been producing 23.2 million tons that cover 66 % of global production (Paivast, 2005). Using the controlled and greenhouse cultivation is one of the most appropriate methods to increase production per unit area. In this method, controlling the effective factors of production such as plant nutrition is the important factor to achieve high performance. Besides the accuracy applied in nutritional regulation of plant roots (both in soil and hypothermic environments), in many cases, foliar nutrition is considered by breeder of greenhouse productions (Tollaee, 2002). Rapid uptake of nutrients and no influence of pH and soil texture as well as providing cations such as Zn and Fein the soil for plants that stabilize these elements and finally being cheaper than other methods are the advantages of foliar nutrition method (Lanauskas and Kvikliene, 2006).

Foliar nutrition is more effective on young leaves, and shortage of macro and micro nutrients can be removed by this factor (Kashi, 1994). Despite various studies on the root nutrition, unfortunately, few studies have been conducted on the effects of foliar application on the growth and yield of greenhouse cucumber. Many growers of this crop use nutrient solution to foliar nutrition, and how it is effective and if it is possible to be replaced by another method are the questions that hardly have been studied (Abdolkarimzadeh, 2006). In recent decade, the Effect of foliar nutrition on cucumbers has been studied in Iran by Farhadi *et al.* (2001). They concluded that using urea 7.5 per thousand as a foliar application for cucumber in fall cultivation had the maximum effects on the performance of total yield, while nitrate 5 per thousand had the highest level of this value in spring cultivation. Karuppaiah *et al.* (2001) studied the effects of folia application using nitrate and the results revealed that the yield of cucumber raised up to 14.5 tons per ha and there were an increase of NPK in plants applying foliar application. Mohamed (1979) investigated the effect of urea fertilizer and nitrophoska as a foliar application and as use in soil on cultivars Baladi and Beit- Alpha.

The results showed there were no significant differences among treatments in terms of the performance of total yield, but marketability of both cultivars reached a significant increase. Majeed and AL-Hamzawi (2010) concluded that the Anfaton effects at concentrations of 0, 600 and 1000 mg/Liter and also calcium nitrate and potassium nitrateat concentrations of 0, 10 and 15 mM on greenhouse cucumber (cv. Al-hatam) revealed the maximum percentage of fruit set were found in 1000 mg/liter. In addition, foliar application with calcium nitrate and potassium nitrateat concentrations of 10 and 15 mM had significant effects on plant height, number of leaves, leaf area, number of flowers, fruit set, dry weight of shoot, total fruits and total yield. There was found an increase of 20-32% in cucumber yield using foliar application compared to irrigation (Soliman, 2002). Also, the concentration of micronutrients reached the highest value in the leaves of cucumber. Warncke (2005) showed there was a remarkable effect on developing the pods and ameliorating internal black spot in cranberry bean seed with boron application at concentration of 0.5 gr/liter. There was no a significant effect of polyethylene mulch and calcium nitrate on blossom end rot, (cv. Charleston gray) (Kashi *et al.,* 2003). Patil *et al.* (2008) investigated the effect of foliar application of micronutrients on growth and yield of tomato (*Lycopersicon esculentum* Mill.) that the results showed using 100 ppm of acid boric as foliar application resulted in an increase of growth and yield. Cucumber is the vegetable that is widely used in different greenhouses of Iran and there is not comprehensive information about foliar application of greenhouse cucumber in the country. Hence, collecting usable data on spraying macro and micro nutrients is necessary to modernized agriculture. The present study aimed to investigate the effects of foliar application using urea, calcium nitrate and acid boric on growth and yield of greenhouse cucumber (cv.Khassib).

MATERIALS AND METHODS

The present study was conducted in Technical and Vocational Training Center of Zibadasht, 15 km far from Karaj city located in near Tehran, on greenhouse cucumber (cv.Khassib) during 2007 and 2008, in a five-month period from March 2007 to July 2008.The soil texture of experimental site was sandy loam. Three chemical compounds were used for foliar application based on split-split-plot design with three replications. Urea fertilizer in two levels (0 and 3 per 1000) of main plots, calcium nitrate in two levels (0 and 10 per 1000) of sub plots and boric acid in two levels (0 and 0.5 per 1000) of sub-sub plots were applied. So, eight experimental treatments were applied for foliar application.

Treatment $U_1C_1B_1$: urea + calcium nitrate + boric acid
Treatment $U_1C_1B_0$: urea + calcium nitrate
Treatment $U_1C_0B_1$: urea + boric acid
Treatment $U_1C_0B_0$: urea
Treatment $U_0C_1B_1$: calcium nitrate + boric acid
Treatment $U_0C_1B_0$: calcium nitrate
Treatment $U_0C_0B_1$: boric acid
Treatment $U_0C_0B_0$: control

In addition, besides the three chemical compounds used for foliar application, fosamko commercial separately was used in 3/1000 ratio on cucumbers. The reason why the fertilizer was selected is to understand the commercial value of used chemical compounds by comparing with fosmako. Fosmako fertilizer is a perfect liquid fertilizer that consists of N 10%, P 4.4%, K 7%, Mg 1900 ppm, Mn 1400 ppm, Zn 700 ppm, Fe 80 ppm, Mo 30 ppm and B 200 ppm. The results of soil experiment are presented in Table 1.

After plowing to a depth of 30 cm and sterilizing the soil by steam, fertilizers including 6-5 g of urea, 9-10 g of P and 5-6 gr of K per square meter were used as starters. Three kg of fully composted and disinfected manure were added for each square meter of soil. 8cm -diameter plastic pots were used in order to obtain the desired seedlings and transfer to the main seedbed. Also, Kaptan was applied to disinfect the pots to control soil-borne diseases and various types of toxin -eating insect larvae. Seedbeds contained 80% coco peat and 20% perlite. The seeds were sown in March, and after 25 days they reached the 4-leaf stage, then they were transferred to the main site. In the main greenhouse, the row spacing was 100cm.

The final density of plants was three numbers per square meter. Drip irrigation with appropriate quality was conducted twice a week at the beginning and every other day from reproductive to harvest stage. Foliar application of urea , calcium nitrate, boric acid and fosamko with, respectively, 3 gr, 10 gr, 0/5 g and 3 gr per liter was applied after the first fruiting using a backpack sprayer in the morning once a week. The cucumbers harvested every other day during study period. Fruit of each treatment were classified into grade 1 and 2 in terms of market -friendly and they were weighed after counting. Leaf area twice was measured during the experiment using Aria Meter (Model AM200) and fruit sugar was determined using refractometer (Model 3T). Moreover, plant length, plant weight, yield, fruit dry matter, plant dry matter were measure and data were analyzed using SAS and MSTATC.

Table1: The analyses of chemical and physical characteristics of soil in experimental site.

Depth Cm	pH	EC (Ds m^{-1})	Organic carbon (%)	Uptakable P (ppm)	Uptakable K (ppm)	Total N (%)	Sand (%)	Silt (%)	Clay (%)
0-30	7.43	1.28	2.73	238.7	392	0.3	68	22	10

RESULTS AND DISCUSSION

Fruit yield: Calcium nitrate had a significant effect on fruit yield at 5% level (Table 2). Spraying calcium nitrate with concentration of 10 per thousand resulted in an increase of yield so that the average of fruit yield in sprayed plants was 3917.9 gr per plant, while this value in non-sprayed plants was 3576.5 (Fig. 1). In addition, boric acid with concentration of 0.5 per thousand had a remarkable effect on fruit yield at 5% level that enhanced the average of yield from 3591.6 to 3902.8 gr per plant by spraying (Fig. 2).

Table 2: Analysis of variance for quantitative and qualitative characteristics.

Sov	df	Mean square: Total fruit yield (gr per plant)	The yield of grade1 fruit (gr per plant)	Number total fruit	The percentage of grade 1 fruit (weighe)	The percentage of sugar fruit	Plant lenght (cm)	Percentage dry matter leaf	Leaf weighe ratio (gr/gr)
Replication	2	661458.357	788345.38	93.630	32.737	0.088	1816.013	3.975	0.015
Urea	1	278354.241^{ns}	37540.86^{ns}	24^{ns}	26.952^{ns}	0.098^{ns}	8300.56*	5.867^{ns}	0.056**
Error(U)	2	172256.918	24163.523	17.389	68.16	0.118	676.199	1.347	0
Calcium Nitrat	1	699118.935*	80426.962^{ns}	68.907*	169.07**	0.018^{ns}	2393.337^{ns}	11.574*	0^{ns}
U×C	1	1992.296^{ns}	1077.359^{ns}	2.2407^{ns}	0.819^{ns}	0.067^{ns}	10.227^{ns}	4.202^{ns}	0.006^{ns}
Error U×C	4	717014.272	806598.252	88.88	27.412	0.033	2570.393	0.881	0.004
Boric Acid	1	581280.125*	1183615.33**	34.241^{ns}	161.029**	0.067^{ns}	1358.226^{ns}	5.415^{ns}	0.009^{ns}
U×B	1	162021.711^{ns}	427360.281*	25.352^{ns}	53.104*	0.003^{ns}	268.893^{ns}	0.427^{ns}	0.01^{ns}
C×B	1	345280.073^{ns}	173026.202^{ns}	46.296^{ns}	2.302^{ns}	0.002^{ns}	1962.041^{ns}	1.37^{ns}	0^{ns}
U×C×B	1	1379937.098**	703540.698**	106.963*	27.807^{ns}	0.581*	7130.004*	0.042^{ns}	0^{ns}
Error B	8	85897.625	50378.835	12.463	7.919	0.055	1468.194	1.92	0.004

The interaction of treatment U*C*B on fruit yield at 1% level was significant, while this value was not found among other treatments (Table 2). U1C0B0 covered the highest yield with 4440 gr per plant, while the minimum yield belonged to control treatment (Table 3). Different factors can affect the yield that the main ones of them are temperature, moisture and plant nutrition. If the amount of these factors is not sufficient for plant, not only the appropriate yield can't be obtained but also results in a reduction of yield. B is an immovable element that directly is uptake via cucumber roots during flowering and fruiting. Since the root system of cucumber is weak, foliar application with boric acid has a remarkable impact on fruiting and subsequently the total yield. Calcium nitrate slowly will be solved in soil solution, so it can't act fast, whereas it is one of the major sources of nitrogen in combination with other fertilizers to develop tree and vegetable growth (Yildirim *et al.*, 2007). Hence, foliar application with calcium nitrate results in an increase of yield and production in young and growing fruits. The augmentation of yield in treatment U1C0B0 due to the facts that pure urea and calcium nitrate have 46% and 16% nitrogen, respectively, i.e., extra nitrogen causes toxicity and branching instead of fruiting. Therefore, not using calcium nitrate in this treatment helps increase yield. This result is similar to those obtained by Jifon and Lester (2006) on muskmelon and Patil *et al.* (2008) on tomato.

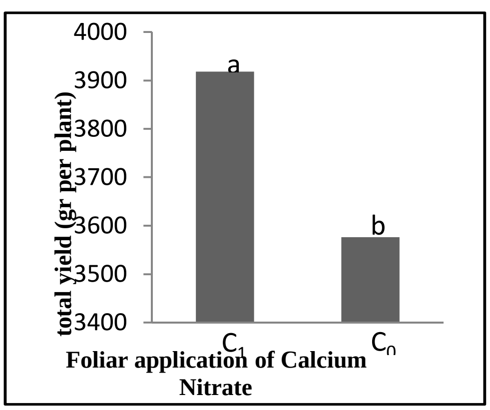

Fig. 1. The effect of foliar application of Calcium Nitrate on fruit yield.

The yield of grade 1 fruit: Among all treatments of simple interaction only boric acid had the significant effect on the yield of grade1 fruit at 1% level (Table 2). The yield average of grade1 fruit in sprayed plants with boric acid was over than 3503 gr per plant, while this value in non-sprayed plants was 3058 gr per plant (Fig. 3). Among two-way interaction treatments, U*B significantly affect the yield of grade1 fruit at 5% level (Table 2). The plants sprayed with boric acid and urea (U1B1) and those that only sprayed with urea reached the maximum yield (Fig. 4). Among three-way interactions, U*C*B statistically had a remarkable impact on the yield of grade1 fruit at 1% level and also the maximum and minimum of this value belonged to U1C0B0 and control, respectively (Table 3).

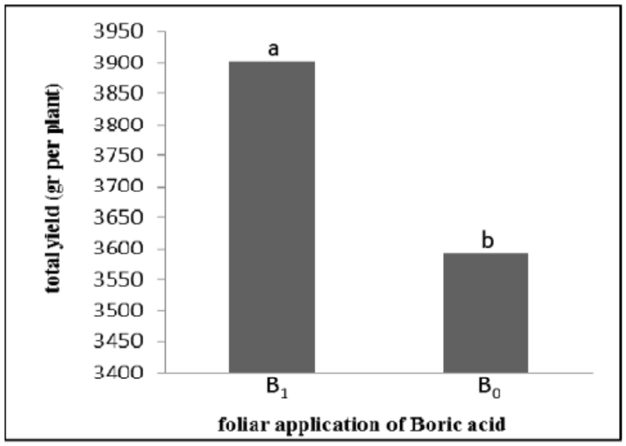

Fig. 2. The effect of foliar application of Boric acid on fruit yield.

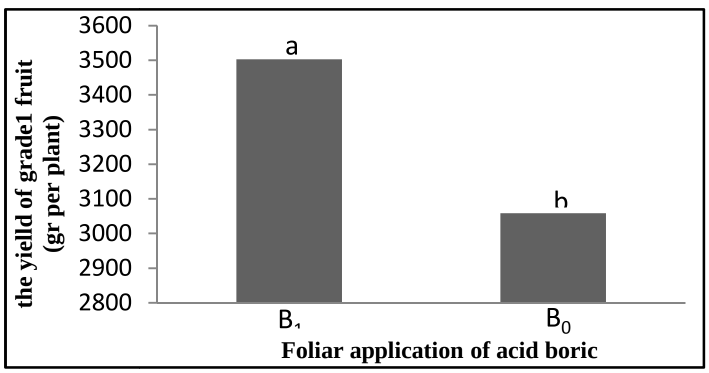

Fig. 3. The effects of foliar application of acid boric on the yield of grade1 fruit.

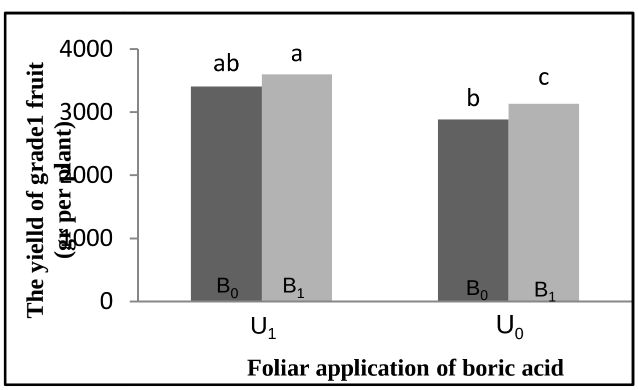

Fig. 4. The effects of foliar application of boric acid and urea on the yield of grade1 fruit.

Table 3: Comparing foliar application with different solutions on quantitative and qualitative characteristics.

Treatments	Total fruit yield	The yield of grade1 fruit	Number total fruit	The percentage of grade 1 fruit	The percentage of sugar fruit	Plant lenght	Percentage dry matter leaf	Leaf weighe ratio
	gr per plant			weighe		cm		gr/gr
$U_1 C_1 B_1$	3817 ^{b}	3619 ^{a}	47.22 ^{abc}	94.67 ^{a}	3.98 ^{a}	412.7 ^{a}	14.52 ^{a}	0.566 ^{a}
$U_0 C_1 B_1$	3102 ^{c}	2735 ^{c}	41.33 ^{c}	88.04 ^{a}	3.31 ^{ab}	410 ^{b}	13.44 ^{a}	0.483 ^{a}
$U_1 C_0 B_1$	3937 ^{ab}	3575 ^{a}	49.77 ^{ab}	90.52 ^{a}	3.44 ^{ab}	417.6 ^{ab}	13.56 ^{a}	0.604 ^{a}
$U_0 C_0 B_1$	3701 ^{b}	3037 ^{bc}	46.77 ^{abc}	80.83 ^{a}	3.65 ^{a}	442.4 ^{a}	13.27 ^{a}	0.526 ^{a}
$U_1 C_1 B_0$	3407 ^{bc}	3102 ^{bc}	43.55 ^{bc}	91.36 ^{a}	3.37 ^{ab}	450.6 ^{ab}	14.70 ^{a}	0.454 ^{a}
$U_0 C_1 B_0$	3980 ^{ab}	3437 ^{ab}	50.22 ^{ab}	86.38 ^{a}	3.57 ^{a}	484.4 ^{a}	12.92 ^{a}	0.465 ^{a}
$U_1 C_0 B_0$	4450 ^{a}	3716 ^{a}	53.33 ^{a}	83.64 ^{a}	3.5 ^{ab}	471.2 ^{ab}	11.93 ^{a}	0.440 ^{a}
$U_0 C_0 B_0$	3083 ^{bc}	2227 ^{bc}	39.66 ^{bc}	84.21 ^{a}	2.88 ^{b}	404.8 ^{b}	11.28 ^{a}	0.434 ^{a}

The number of fruit: It can be found from the analysis of variance (Table 2) that there is statistically a significant effect at 5% level only for the treatment sprayed with calcium nitrate among main effects so that the number of fruit with 48.97 had the maximum level among all sprayed treatments (Fig. 5).

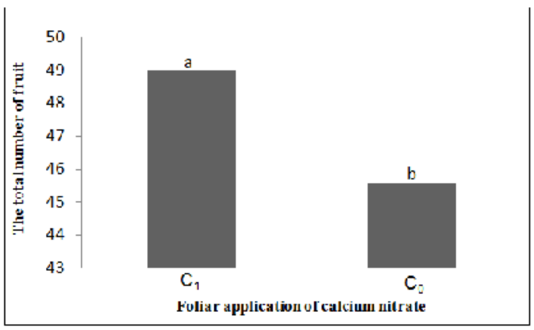

Fig. 5. The effects of foliar application of calcium nitrate on the total number of fruit.

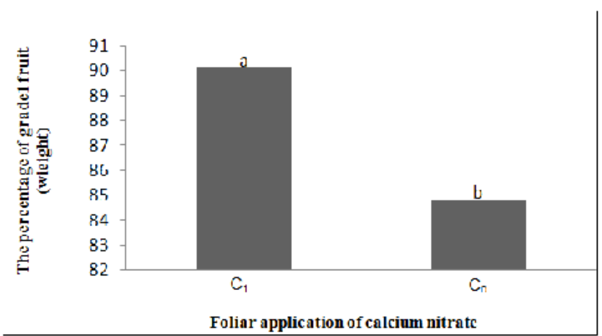

Fig. 6. The effect of foliar application of calcium nitrate on the percentage of grade1 fruit.

For three-way interaction, U*C*B had the remarkable effect on the total number of fruit at 1% level (Table 2) so that the highest and lowest amount of the number of fruit belonged to U1C0B0 (mean: 53.33) and control (mean: 39.66), respectively (Table 3).

The percentage of grade1 fruit: The treatments sprayed with calcium nitrate and boric acid had significant impacts on the percentage of grade1 fruit at 1% level.

The results indicated that the average percentage of grade1 fruit sprayed by calcium nitrate was more than 90 percent, while this value for not sprayed plants was approximately 84 percent (Fig. 6). Moreover, this trend was found for the treatment sprayed by acid boric (Fig. 7). On the other hand, there was a significant effect for U*B at 5% level (Table 2), i.e., the maximum and minimum of grade1 fruit belonged to U1*B1 (mean: 92.5) and control, respectively (Fig. 8).

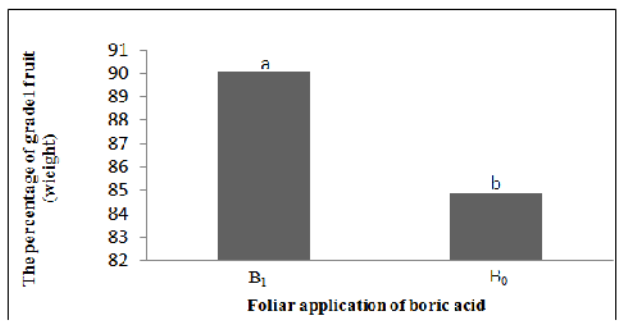

Fig. 7. The foliar application effect of boric acid on the percentage of grade1 fruit.

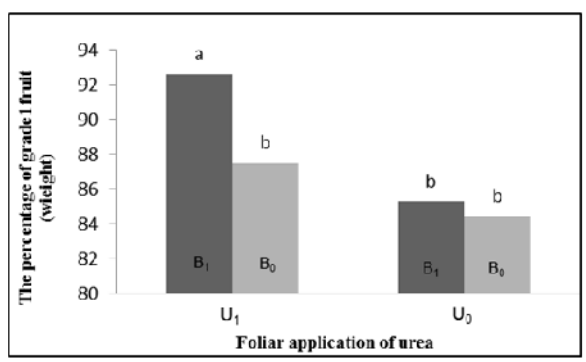

Fig. 8. The effects of foliar application of urea and acid boric on the percentage of grade 1 fruit.

The reason of the findings due to the fact that B as a main component of cell wall of plants makes poly hydoxy compounds that enhances the stability of cell wall. Boron deficiency in plants produces manifold symptoms: many functions have been postulated. Deficiency symptoms first appear at growing points, within hours in root tips and within minutes or seconds in pollen tube tips, and are characterized by cell wall abnormalities.

Boron-deficient tissues are brittle or fragile, while plants grown on high boron levels may have unusually flexible or resilient tissues. Nasefnadia *et al.* (2006) and Yildirim (2007) reported the similar results for peanut and broccoli. Calcium is an essential element for growth of young tissues, roots and fruits and also nitrate can be directly available for plant and results in an increase of calcium uptake. Moreover, Itagi and Hiki (1956) expressed the urea fertilizer due to its N (46%) decreases inappropriate and deformed fruits by spraying.

The sugar of fruit: Among all main effects and interactions, only U*C*B statistically had significant effect at 5% level on sugar of fruit. U1C1B1 and control reached the maximum (mean: 3.98) and minimum sugar of fruit (Table 3). Because about 96-97% of cucumber content is water and sugar amount is low, B makes possible and easier the sugar transportation in plants. B and sugar make organic complexes named Sugar Borat and passing these complexes from cell membrane is easier than sugar molecules. Since B is sufficient for plant, transporting the sugar to growing parts of plant is easier and this value plays an important role in post-harvesting processes of cucumber. Hence, the findings of this research are in accordance with results obtained by Lanauskas *et al.* (2006) on strawberry, Kolota and Osinska (1999) on tomato, Arora and Sing (1970) on guava and Bacha *et al.* (1993) on grape.

Plant length: Analysis of variance (Table 2) shows there is statistically a significant effect at 5% level only for the treatment sprayed with urea, for treatments of main effects, which had the maximum plant length with mean of 456.56cm (Fig. 9).

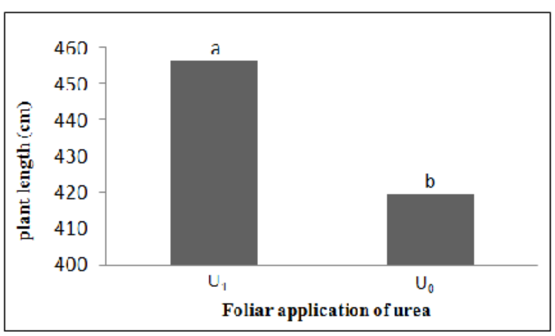

Fig. 9. The effects of foliar application of urea on plant length.

Only U*C*B had a remarkable impact on plant length among all interactions (Table 2). U0C1B0 reached the highest plant length (484.4cm) and control had the lowest plant length (Table 3).

Generally, the growth of cucumber depends on genetic features, temperature and soil productivity. The results are in consistence with those concluded by Kashi *et al.* (2003) on the growth and yield of strawberry. In addition, Halevy (1985) reported that besides the time of cultivation and appropriate temperature (25-26?c), other factors like high distance among plants and high CO_2 are important in plant length.

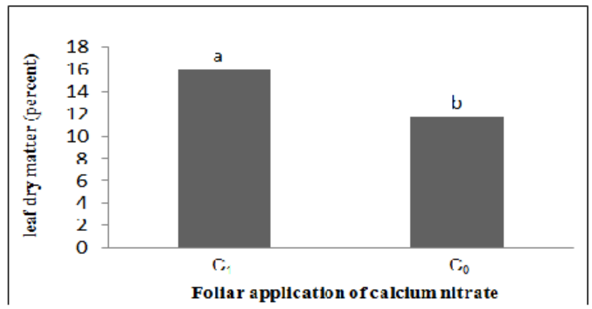

Fig. 10. The effects of foliar application of calcium nitrate on leaf dry matter.

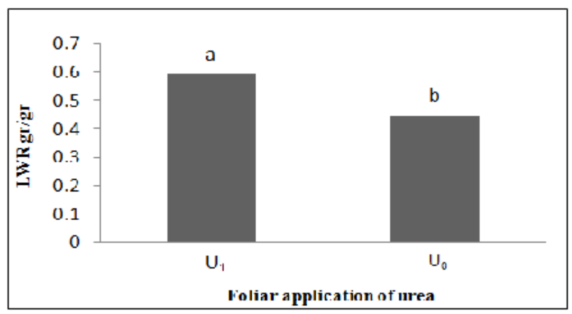

Fig. 11. The effect of foliar application of urea on LWR.

Leaf dry matter: The highest level of this component was for calcium nitrate that indicated the significant effect at 5 % level with the mean of 15.89 (Fig. 10).

LWR: As is shown by Table 2, among treatments of main effects, only foliar application of urea statistically had a significant effect on LWR at 1% level (Fig. 11).

The means followed by same symbol in each column are not significantly different according to Duncan,s comparison tests ($p<0.05$)

The effects of various nutrients on studied traits were considered, subsequently, the treatments were compared with fosamko.

Comparing the spraying treatments with fosamko on grade 1 fruit: as is seen by Table 4, there was not a significant difference between the mean of spraying treatments and fomasko.

Table 4: Comparing spraying treatments with fosamko (T test).

Trait	Treatment	Comparing factor	Mean variation	Standard error	Significant percent
The percentage of grade 1 fruit	U_1	fosamko	-1.54944 ^{ns}	1.91962	0.42
	C_1	fosamko	-0.96889 ^{ns}	1.58327	0.54
	B_1	fosamko	-1.03278 ^{ns}	1.83746	0.58
	U_1C_1	fosamko	0.27556 ^{ns}	1.85869	0.88
	U_1B_1	fosamko	1.51444 ^{ns}	1.67993	0.38
	C_1B_1	fosamko	1.93111 ^{ns}	1.49809	0.21
	$U_1C_1B_1$	fosamko	3.58667 ^{ns}	1.98828	0.09
The percentage of leaf dry matter	U_1	fosamko	1.72667 **	0.45654	0.001
	C_1	Fosamko	1.75722 **	0.55895	0.005
	B_1	Fosamko	1.53778 *	0.60158	0.01
	U_1C_1	Fosamko	1.84333 **	0.48506	0.002
	U_1B_1	Fosamko	1.89889 **	0.55676	0.004
	C_1B_1	Fosamko	2.47111 **	0.57674	0.001
	$U_1C_1B_1$	Fosamko	2.38222**	0.59794	0.002
Yield	U_1	Fosamko	-196. 2317 ^{ns}	274.5629	0.48
	C_1	Fosamko	-264.7344 ^{ns}	285.0959	0.36
	B_1	Fosamko	61.56833 ^{ns}	245.868	0.80
	U_1C_1	Fosamko	-257.5997 ^{ns}	362.5277	0.48
	U_1B_1	Fosamko	178.41 ^{ns}	272.4121	0.52
	C_1B_1	Fosamko	-151.4872 ^{ns}	331.8671	0.65
	$U_1C_1B_1$	Fosamko	-23.90667 ^{ns}	415.70847	0.95

However, there was statistically found a sharp difference at 1% and 5% level between fomasko and non-spraying treatments on the percentage of grade1fruit (Table 5). **Comparing spraying treatments with fosamko on grade 1 fruit:** As is shown by Table 4, when we compare the spraying treatments with fomasko, it can be found that the spraying treatments affected leaf dry matter significantly at 1% and 5% level, while this value was not found for non-spraying treatments (Table 5).

Table 5: Comparing spraying treatments with fosamko (T test).

Trait	Treatment	Comparing factor	Mean variation	Standard error	Significant percent
The percentage of grade 1 fruit	U_0	fosamko	-4.68278 *	1.91189	0.02
	C_0	fosamko	-6.27722 *	2.28964	0.01
	B_0	fosamko	-6.21333 **	2.10870	0.008
	U_0C_0	fosamko	-7.15222 **	2.19123	0.006
	U_0B_0	fosamko	-5.78556 *	2.14642	0.01
	C_0B_0	fosamko	-8.55778 **	2.63461	0.006
	$U_0C_0B_0$	fosamko	-6.86889 *	2.80356	0.03
The percentage of leaf dry matter	U_0	fosamko	0.56833 ^{ns}	0.64936	0.39
	C_0	Fosamko	0.36833 ^{ns}	0.48909	0.46
	B_0	Fosamko	0.58778 ^{ns}	0.49617	0.25
	U_0C_0	Fosamko	-0.53444 ^{ns}	0.43128	0.23
	U_0B_0	Fosamko	-0.040 ^{ns}	0.61594	0.94
	C_0B_0	Fosamko	0.13222 ^{ns}	0.51386	0.80
	$U_0C_0B_0$	Fosamko	-0.86222 ^{ns}	0.53627	0.13
Yield	U_0	Fosamko	13.63500 ^{ns}	247.86828	0.95
	C_0	Fosamko	76.61556 ^{ns}	227.22091	0.73
	B_0	Fosamko	-249.68722 ^{ns}	271.17913	0.36
	U_0C_0	Fosamko	175.19889 ^{ns}	317.87020	0.59
	U_0B_0	Fosamko	-59.82889 ^{ns}	295.46648	0.84
	C_0B_0	Fosamko	-198.95667 ^{ns}	278.25094	0.48
	$U_0C_0B_0$	Fosamko	-257.99556 ^{ns}	398.95851	0.53

Comparing spraying treatments with fosamko on yield: It can be seen from the Tables 4 and 5, there was no significant differences between using and not using nutrition compared to fosamko on yield.

CONCLUSION

According to the findings of the present study the following factors can be concluded:

1. Among the main effects, calcium nitrate played the eminent role on most traits, after that boric acid and finally urea carried this role.
2. Among two-way interaction, only U1B1, as foliar application, significantly affected the yield of grade 1 fruit.
3. Among three-way interactions, only U1C0B0, as foliar application, significantly affected the yield of grade 1 fruit, total fruit and the number of fruit.
4. There was no a significant change on qualitative features of cucumber using nutrition compared to fosamko. Hence, cucumber production can be performed by cheaper methods with no change in qualitative characteristics. Finally, due to the fact that cucumber is one of the most important vegetables in Iran, it is suggested that various studies with different fertilizers will be conducted on cucumber.

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