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Original Research Article

Impact of foliar application of calcium and boron on growth, nutrients content and fruit quality of fig cv. "Sultani" grown under saline condition

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Abstract

During two seasons (2015-2016) an experiment conducted in order to assess effect of foliar application with calcium and boron on growth performance and fruit quality of fig cv "Sultani". In this context, calcium applied at 2.5 and 5 ml/l as (Amino acids + 14% CaO) and boron at 1 ml/l and 2 ml/l as (Mono Ethanol Di-amin + 15 % B) individually or in combination. At the end of experiment at each season, samples of leaves and fruits were collected to determine fresh and dry of leaves weight, leaf moisture content, leaf area, leaf nutrients content, fruit volume, fruit fresh and dry weight, fruit dimensions, fruit firmness, fruit moisture content, TSS, acidity , ascorbic acid and total anthocyanin. Obtained results showed that the most applied treatments had a positive impact on recorded vegetative growth parameters and nutrients content in leaves. Moreover, these treatments were enhanced measured fruit quality parameters whereas calcium at (5 ml/l) in combination with boron at (2 ml/l) produced the highest values of leaf fresh and dry weight, leaf area, leaf contents of (nitrogen, phosphors calcium and boron), Fruit ascorbic acid content, and TSS, while using calcium alone at 5ml gave the best result for fruit volume, and fruit fresh weight. However, better firmness obtained when applied treatment (Ca 2.5 ml/l + B 1 ml/l). Also, the highest acidity and anthocyanin content resulted of boron treatments individually without significant differences. Generally, applying calcium and boron in combination led to increase in studied vegetative growth, enhancement in nutrient status and improvement fruit quality. These results could be attributed for critical roles of both of calcium and boron in cell division, cell wall structure stability, metabolic of (sugar, carbohydrates and IAA) and role of boron in mobility of calcium and its metabolism. Foliar application could be recommended as supplementary tool but not essentially method to fertilization program.

Keywords: foliar application, calcium and boron application, fig, Sultani cultivar, fruit quality and nutritional status

INTRODUCTION

Commercial value and demand on fig fruits (*Ficus carica* L.) grow up day by day as a result of increasing awareness of its nutrition value. Fig fruit considered a rich fruit with essential nutrients (potassium 14%, calcium

15.8%, and iron 30%), vitamins (thiamin (B) 17.1% and riboflavin (B2) 6.2%), phenol compounds, considerable percentage of fibers, several carotenoids, including lutein, lycopene, â-carotene, and R-carotene and amino acids (17 type of amino acids i.e. aspartic acid and glutamine). Also, fig fruits are sodium free as well as fat and cholesterol free, thereby it have a great impact on human health and fitness. However the most critical barrier for fig fruit trade is its susceptibility for prompt spoilage and microbial attack under room temperature, thereby lead to prompt decay fruits and wastage during handling (Solomon et al., 2006; Elleuch et al., 2011 and Martínez-García *et al.,* 2013).

In this approach, several studies were focused on pre-harvest practices which have a positive impact on fig fruit quality. One of these practices is spraying calcium and boron (Ca and B) whether individually or in combination. Both of calcium and boron played important roles that reflect on productivity and fruit quality (i.e. fruit set, fruit firmness, fruit size and TSS). Foliar fertilization has several merits i.e. more efficient than soil application (Chandler et al., 1931), prompt responses and equal distribution (Umer et al., 1999). Some authors suggested that foliar application more efficient by10-20 times than soil application (Zaman and Schumann, 2006). The importance of micronutrients (i.e. B) essential attributed to its roles in tree yielding and fruit quality (Shoeib and El Sayed, 2003). In regard to function of boron, several studies indicated that, boron has an important role as micronutrients for trees in hormone movement activate ion absorption, flowering, pollen growth (Robbertse et al., 1990; Talaie et al., 2001; Wojcik and Wojcik, 2003; Baldi et al., 2004), enhancing fruit set, fruit development (Peryea et al., 2003) and its deficient resulted in reduction of yield (Raese, 1989). Boron is essential element in several processes for instance protein synthesis, transport of sugars and carbohydrate Abdel-Fattah et al., 2008).

Also, Calcium as a macronutrient can be applied as foliar application. Spraying (Ca^{2+}) has a positive impact on some fruit quality parameters (Asgharzade and Babaeian, 2012). They reported that, calcium played a positive role in increasing yield, fruit firmness, TSS increment and prolong shelf life of fruit. Calcium contributes in blocking physiological disorders, respiration rate decreasing, delaying development and decaying fruit tissues (Magee et al., 2002). Plich and Wojcik (2002) showed that spraying cv. Stanley and cv. Dąbrowicka Prune (*Prunus domestica* L.) by calcium resulted in significantly increase of fruit firmness at harvest and consequently a slower softening during long-term storage at low temperature.

Moreover, Shukla (2013) reported that, when gooseberry sprayed with calcium, boron and combination of (Ca + B), results indicated that the maximum yield, dry matter, juice content, vitamin C, fruit size and fruit length were achieved with combination treatment at 0.4%. Generally, spraying combination of (Ca+B at 0.4%) produced more marketable fruit in comparison with control.

Current experiment was conducted on 'Sultani' cultivar of fig (*Ficus carica* L.) to assess whether pre-harvest foliar applications of Calcium and Boron individually or their combination influences on growth performance and fruit quality.

MATERIAL AND METHODS

This study was conducted during two successive seasons of 2015-2016.Nine treatments were applied on 27 homogenous trees of fig (*Ficus carica* L.) gown in a saline sandy soil located at Abo-Kalam farm, Tour Sinai, South Sinai province (Table 1) showed chemical composition of soil).

The selected fig trees were cultivated at 4*5m distance under drip irrigation and received the same recommended horticultural practices. Both of calcium as (Amino acids + 14% CaO) and boron as (Mono Ethanol Di-amin + 15 % B) were sprayed at different rates as follows:

T1= Control
T2= Ca 2.5 ml/l
T3= Ca 5 ml/l
T4= B 1 ml/l
T5= B 2 ml/l
T6= Ca 2.5 ml/l + B 2 ml/l
T7= Ca 2.5 ml/l + B 1 ml/l
T8= Ca 5 ml/l + B 1 ml/l
T9= Ca 5 ml/l + B 2 ml/l

Untreated trees (control) were sprayed with only water. Each treatment was repeated three times (March, May and July), and applied on three replicates (tree /replicate).

Leaf area and nutrient contents

Leaf area was determined at the end of each growing season during the first week of September according to (Ahmed and Morsy, 1999) and leaf samples were collected, washed and dried at 70℃ until constant weight and then grounded for determining the following nutrient elements (Percentage as dry weight), N, P, K, Ca,Mg andBwere determined using the methods outline by (Wilde et al., 1985).

Fruits

Mature fig fruits *(Ficus carica* L.) of Sultani cultivar were collected from treated and untreated trees. Un-damaged fruits, uniform in shape, weight, and firmness were selected, packed and transported carefully to the

Table 1. Soil characterization in experiment location (Abou-Kalam farm, Tour Sinai, South Sinai province).

Depth	$CaCO_3$ %	pH 1: 2.5	EC dSm^{-1}	Soluble cations (meq/l)				Soluble anions (meq/l)			
				Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO^{-}_3	HCO^{-}_3	Cl^{-}	SO^{-}_4
0-30	10.5	8.68	8.80	15.25	12.7	58.6	1.4	-	3.95	54.6	29.6

laboratory of Agricultural Development System (ADS) Project in Cairo University. The following parameters were determined in both seasons' samples (leaves and fruits) as follows:

Fruit physical properties

Fruit fresh and dry weight (gm), volume (cm^3) and moisture percentage in the fruit were assessed. Fruit firmness was determined using Ametek pressure tester. Firmness of 5 fruits from each replicate was measured at two opposite points on the equator of each fruit. Results were calculated as (lb/$inch^2$). Also, average of length and width of 5 fruits were measure for each replicate. Fruit samples were ground in electric blender for freshly prepared juice, total soluble solid content was measured for each fruit with a digital refractometer (Atago, PR 32, Japan) and express in percentage (A.O.A.C., 1990).

Fruit chemical properties

Total acidity (TA %) of fruit juice was determined by titrating 5 ml juice with 0.1 N sodium hydroxide using phenolphthalein as an indicator. Ascorbic acid content (VC, mg/100 g fresh weight): was measured using 2, 6 dichlorophenol indophenols' titration methods as described by (A.O.A.C., 1990).

Total anthocyanin content (mg/100 g fresh weight)

Fruit skin and flesh anthocyanin content was measured calorimetrically at 535 nm according to (Fuleki and Francis, 1968).

Statistical analysis

The design for this experiment was a randomized completely block design (RCBD) with three replications. Data were analyzed with the analysis of variance (ANOVA) procedure of MSTATC program. Treatments means were compared by Duncan's multiple range tests at 5% level of probability in the average of two seasons of study (mean with different letter(s) are significantly different) (Steel and Torrie, 1980).

RESULT AND DISCUSSION:

Vegetative growth

Data in (Table 2) showed that, the most examined treatments had a positive impact on leaf fresh weight, leaf moisture percentage, leaf area, and leaf nutrient content. Calcium treatments at high concentration (5ml/l) increased leaf fresh weight, however leaf dry weight deceased with these treatments, thereby, the increment in leaf fresh weight referred to increasing leaf moisture content. In regard to impact of boron applications, data indicated that high concentration of boron had a negative impact on leaf fresh and dry weights in comparison to control treatment, however leaf moisture percentage recorded high level at low concentration of boron (1 ml/l). Meanwhile, combination of calcium and boron resulted in high level of leaf fresh and dry weight special at high levels of calcium and boron. High values of leaf fresh and dry weight produced as result from spraying (Ca 5 ml/l + B 2 ml/l). Moreover, these treatments had a positive reflection on leaf area whereas the highest value of leaf area produce d as a results of (Ca 5 ml/l + B 2 ml/l) treatment. However, applied calcium o boron alone resulted in decreasing in leaf area comparing to control treatments. These results supported by findings by ((Mazher et al., 2006 and Roy et al., 2006) who showed that, boron play an important role in calcium mobility inside plants and that can interpret why joining calcium and boron together in treatments almost had a considerable positive effect of vegetative growth in comparison with other treatments, especially, several studies stated that calcium has a slow mobility since it driven by transpiration influx. Also, Marschner (Marschner, 1995) mentioned that, plant growth has been shown to be affected as consequences of applying both of calcium and boron individually or gathering due to their important role in cell division and expansions. The risk of calcium deficiencies can be occurred and increased as a result of high growth rate of apical meristems and tissues expanding and that has a negative impact on cell wall stability and membrane completeness (Marschner, 2011). Under such these circumstances of nutrients deficiency, foliar application with calcium considered an alternative and prompt method to recover calcium deficiency to the sites of high needs to calcium (Marschner, 2011 and Gislerød, 1999).

In regard to boron, it has been reported that boron is

Table 2. Effect of calcium and boron applications on some vegetative growth parameters of fig cv" Sultani"

Parameters / Treatments ml l^{-1}	Fresh weight (gm)	Dry weight (gm)	Moisture content (%)	Leaf area (cm^2)
Control	4.633 bc	3.883 b	16.3 e	26.77 b
Ca 2.5	3.117 d	2.33 e	26.4 d	23.43 c
Ca 5	4.910 b	2.167 e	56.1 a	15.63 bc
B 1	4.493 bcd	2.260 e	57.53 a	26.93 b
B 2	3.217 cd	1.703 f	43.73 b	14.8 d
Ca 2.5 + B 1	5.577 ab	3.527 c	44.4 b	27.13 b
Ca 2.5+ B 2	5.76 ab	3.08 d	46.23 b	23.47 c
Ca 5 + B 1	6.803 a	3.613 bc	46.53 b	25.63 bc
Ca 5 + B 2	7.043 a	4.287 a	36.7 c	31.07 a

one of important critical factors to plant growth and leaf and stem deformations (Ecke et al., 2004), whereas boron involved in an important processes in plant i. e. accelerate of cell division and differentiation, cell wall synthesis, lignification and cell wall structural integrity (Mazher et al., 2006) thereby keep meristematic activity (Marschner, 1995 and Jones, 2003), sugar transport, metabolism of several vital compounds (i. e. carbohydrates, phenol and Indole Acetic Acid), and respiration. In addition, boron enhances necessary compounds for metabolic processes and building organs thereby vegetative growth (Mazher et al., 2006; Roy et al., 2006 and Marschner, 1995).

Nutritional status of leaves

General, the most of applied treatments were reinforced nutrient status in leaves of sultani fig cultivar. Whereas applied treatments of calcium and boron individually or in combination resulted in reinforced nutrients status. Also, combination treatments were more effective than individually treatments. (Table 3)

Nitrogen

In regard to effect of calcium and boron treatments on leaf nutrients content, Data in (Table 3), it is strongly indicated that, all tested treatments enhanced leaf nitrogen content and the considerable nitrogen content obtained when boron applied alone at (1m) or gathering calcium and boron a high levels (Ca 5ml/l + B 1ml/l).

Phosphorus

Leaf phosphorus content, didn't record a clear trend, however gathering calcium and boron improved phosphorus leaf content and boron at (1 ml/l) or boron at 2ml combined with calcium whether at 2.5 or 5 ml/l markedly raised level phosphorus content in leaves.

Potassium

All treatments markedly increased leaf potassium content comparing with control, while high level of potassium resulted of foliar applied either Calcium at (2.5 ml/l) or Boron at (2 ml/l).

Calcium

Concerning with calcium status in leaves, the study showed that calcium level markedly increased by applying tested treatments and combined boron to calcium treatments improved these increments, whereas the highest levels of calcium in leaves recorded with calcium joined to B at (Ca 2.5 ml + B 2 ml, Ca 5 ml + B 1ml and Ca 5 ml + B 2 ml) without significant differences.

Magnesium

Most treatments significantly increased leaf magnesium content comparing with control, the highest level of magnesium produced when (Ca 5 ml/l+ B 1 ml/l) was applied.

Boron

In respect of effect of tested treatments on leaf boron content, data didn't show clear trend. Generally, combination calcium and boron recorded significantly high levels of boron in leaves.

The obtained results were in the same line of findings of Wójcik and Lewandowski (2003). They studied effect of foliar application of calcium and boron on yield and

Table 3. Effect of calcium and boron applications on leaf nutrients content of fig cv“Sultani”

Nutrients / Treatments ml l^{-1}	N	P	K	Ca	Mg	B
	%					ppm
Control	1.58 de	0.247 abc	1.86 e	1.81 f	0.76 e	114.2 bc
Ca 2.5	1.69 bc	0.213 e	3.88 a	2.48 d	0.76 e	93.43 d
Ca 5	1.63 cd	0.24 cd	2.72 c	2.8 c	0.84 bc	87.68 d
B 1	1.77 a	0.26 ab	2.38 cd	2.2 e	0.81 d	115.4 bc
B 2	1.66 bc	0.213 e	3.84 a	2.8 c	0.83 c	70.23 e
Ca 2.5 + B 1	1.65 bc	0.243 bc	2.36 d	2.65 cd	0.79 d	110.9 c
Ca 2.5+ B 2	1.56 e	0.253 abc	2.57 cd	3.16 b	0.85 b	123.5 ab
Ca 5 + B 1	1.63 cd	0.223 de	3.16 b	4.22 a	0.88 a	126.2 a
Ca 5 + B 2	1.72 ab	0.263 a	2.54 cd	4.26 a	0.79 d	122.8 ab

quality of strawberry. Their results indicated that leaf and fruit content of calcium or boron increased by spaying calcium or boron respectively. Besides, several authors (Mazher et al., 2006 and Roy et al., 2006) stated that there is strong evidence on role of boron in calcium mobility inside plants. Also, according to findings of Serrano et al. (2004) and Manganaris et al. (2006) it should be noted that there are several factors effect on impact of pre-harvest foliar application including cultivar, nutrients source, methods and timing of treatment, as well as location of farm, environmental conditions. Whether nutrient content done through roots or leaves will be transported to leaves where metabolic processes in leaves, so leaves analysis considered an effective tool to diagnose nutritional status of trees, and in spite of that, there are differences in leaf nutrient content as a result of progressing leaf age whereas Marschner (2011) stated the nutrient concentration become diluted in mature leaf than young one.

About Mg results, these results were confirmed by Bonomelli and Ruiz (2010) who found that calcium and boron applications had increased the Mg uptake in grape (Thompson Seedless).

Finally, foliar application could be a supplementary but not essentially method to fertilization program (Mustafa *et al.*, 2011 and Hagagg *et al.,* 2012).

Physical parameters of fig fruit

Data in (Table 4) indicated that the most treatments have a positive impact on fruit fresh weight, fruit volume, fruit index, fruit firmness, fruit dry weight and fruit moisture.

Fruit fresh and dry weight and moisture content

Control treatment produced the lowest value of fruit fresh and dry weight (41 and 27.73 gm) respectively in comparing to other treatments. Meanwhile, spraying calcium (5ml/l) resulted in producing the highest value of fruit fresh and dry weight (64.33 and 37.73 gm) respectively. Moreover, data in (Table 4) indicated that increasing concentration of calcium or boron separately led to increasing both fruit fresh and dry weight. But this trend was reversed by increasing boron concentration in presences of calcium.

Also, Table (4) showed that fruit moisture increased markedly by applied calcium and boron individually or in combinations and the highest moisture content was obtained when calcium applied alone at (2.5 ml/l). Also, it can be noticed that, this parameter decreased by increasing calcium or boron individually. While, this trend didn’t become clear when both of calcium and boron applied together.

Fruit volume and dimensions

From table (4) it can showed that calcium at (5 ml/l) produced the highest level of volume of fig fruits, while calcium at 5ml/l gathering with boron (1 ml/l) resulted in higher length in comparing with other treatments. However, the highest width produced when boron applied alone at (1 or 2 ml/l) with slight insignificant differences. Generally all treatments were improved volume and fruit dimensions in comparing with control treatment.

These results were in the same side of findings by Chen et al. (1998) who mentioned that applying calcium alone as foliar increased berry fruit size. Also, Baghdady et al. (2014) mentioned that, foliar application of calcium, chelated zinc and boron on Valencia orange trees markedly improved fruit weight and yield in comparing with other treatments. These increments may be attributed to enhance calcium synthesis by boron feasibility, which decreases respiration rate, that might maintains fruit moisture content (Muazzam et al., 2012). Moreover, improving physical parameters of fruits may be referred to the enhancement of fruit growth rate and uptake of both Ca and/or B nutrients that increasing

Table 4. Effect of calcium and boron applications on physical characteristics of fig fruits cv Sultani

Characteristics / Treatments (ml l^{-1})	Fresh weight (gm)	Dry weight (gm)	Moisture content (%)	Volume (cm^3)	Length (cm)	Width (cm)	Firmness ($lb/inch^2$)	Total Soluble solids (%)
Control	41.00 e	27.73 e	60.37 f	37.00 d	3.87bc	3.87 ab	11.00 e	13.63 f
Ca2.5	59.00 b	30.53 d	79.78 a	55.00 ab	3.97bc	3.83 ab	19.33 c	19.17 d
Ca5	64.33 a	37.73 a	65.55 d	56.33 a	3.73c	3.8 0 abc	21.67 b	21.07 c
B 1	55.00 c	33.91 bc	66.05 d	53.00 abc	4.23ab	4.03 a	21.33 bc	16.30 e
B2	55.33 bc	34.00 bc	66.03 d	53.33 ab	4.27ab	4.10 a	21.33 bc	16.00 e
Ca2.5 +B 1	53.00 c	35.74 ab	69.78 c	49.00 c	3.50 c	3.63 abc	24.00 a	18.97 d
Ca2.5+ B 2	43.00 de	32.62 cd	72.23 b	38.00 d	4.33ab	3.70 abc	13.67 d	17.5 de
Ca5+ B1	45.00 d	35.61 ab	65.84 d	41.00 d	4.53a	3.30 c	15.67 d	24.23 b
Ca5+ B 2	53.00 c	37.52 a	61.61 e	51.00 bc	4.33ab	3.50 bc	22.33 ab	27.00 a

Metabolic processes rates. These findings were in the same line of what reported by Desouky et al. (2007) and Harhash and Abdl-Nasser (2010).

Total Soluble Solids content (TSS)

As consequences of applied treatments, data in (Table 4) showed that all applied treatments resulted in increasing in TSS content compared with control treatment and Ca (5 ml) in combination with B (1 or 2 ml/l) produced the highest values of TSS (24.23 and 27 %) respectively. Current results are in harmony with that found by Plich and Wojcik (2002) on plum who mentioned that, calcium treatments were more beneficial for fruit total soluble solids than control. Also, Wójcik and Lewandowski (2003) mentioned that strawberry fruits treated with calcium alone or in combination with boron had higher T.S.S. than control. Besides, both of Sajida and Hafeez-ur-Rehman (2000) on sweet orange and Abd El-Razik and Abdrabboh (2008) on Clementine reported that TSS % was increased by boron applications.

Firmness

Application calcium and boron whether individually or in combination resulted in a positive effects on fruit firmness and the highest value of fruit firmness resulted of applying (Ca 2.5 + B 1) as shown in (Table 4). Present results came in the same trend with previously mentioned by Plich and Wojcik, who stated that applying calcium resulted in fruit firmness and thereby delaying softening during long-term storage. This effect could be attributed to role of calcium in constancy of cell wall and delaying fruit softening (Picchioni et al., 1995). Also, Wójcik and Lewandowski (2003) mentioned that strawberry fruits treated with calcium alone or in combination with boron have higher firmness (more resistant to be infected by *Botrytis* rot) than non-treated fruits thereby they recommended to treat fruits with calcium to improve shelf-life of strawberry fruit. Also, Conway et al. (1994) reported that, spray calcium as pre-harvest application may be considered a good strategy to improve fruit quality and reduce fungicides usage. Calcium is an essential element as well as a crucial regulator of growth and development in plants and participates in cross-linking negative charges, especially on the carboxylic residues of pectin, imparting significant structural rigidity to the cell wall (Hepler and Winship, 2010).

Fruit chemical parameters

Generally, data in (Table 5) indicated that, the majority of applied treatments had a positive impact on measured fruit chemical parameters. Whereas, acidity, ascorbic acid content and total anthosyanine were increased by applying calcium and boron treatments. Treatment (Ca 5ml + B 2 ml) produced the highest value of ascorbic acid content, while applying born alone at (1 or 2 ml) produced high value of acidity and anthocyanin without significant differences.

Total acidity

From (Table 5) it was noticed that applied Ca (2.5 or 5 ml/l) separately had a positive impact on acidity (0.37 and 0.42 % respectively) while applied boron at (1 or 2 ml/l) alone produced the highest value of total acidity (0.7 and 0.72 respectively) in comparison with tested treatments. However, increasing boron concentration from (1 to 2 ml) in presence of calcium (2.5 or 5) resulted in decreasing acidity value.

Table 5. Showed chemical parameters for fig fruit under studied treatments

Characteristics / Treatments ml l^{-1}	Total Soluble solids (%)	Total acidity (%)	Ascorbic acid (mg/100gmF.W.)	Total anthocyanin (mg/100gm F.W.)
Control	13.63 f	0.23 e	21.33 b	50.73 e
Ca 2.5	19.17 d	0.37 c	27.33 a	74.73 c
Ca 5	21.07 c	0.42 b	26.00 a	81.19 b
B 1	16.30 e	0.70 a	26.00 a	101.40 a
B 2	16.00 e	0.72 a	26.33 a	101.33 a
Ca 2.5 +B 1	18.97 d	0.21 f	25.00 a	76.60 c
Ca 2.5+ B 2	17.5 de	0.20 f	22.00 b	74.38 c
Ca 5 + B 1	24.23 b	0.31 d	27.67 a	54.39 de
Ca 5 + B 2	27.00 a	0.25 e	27.33 a	57.77 d

Ascorbic acid

In respect to ascorbic acid content, all applied treatments produced increment in ascorbic acid content and these increments ranged from (22 to 27.33 mg/100gm F.W.) in comparison to control treatment (21.33 mg/100gm F.W.). Also, applied (Ca 2.5 ml/l) individually or (Ca 5 ml) in combination with boron (1 or 2 ml/l) resulted in increasing ascorbic acid content (27.33, 27.26 and 27.33).

Total anthocyanin

Applying boron alone at (1 or 2 ml/l) produced the highest value of total anthocyanin (101.4 and 101.33 mg/100gm F.W.) respectively. Meanwhile adding calcium to boron treatments produced a moderate values of total anthocyanin but still higher than control treatment (50.73 mg/100gm F.W.).

Current results are in harmony with that found by Sajida and Hafeez on sweet orange and (Abd El-Razik and Abdrabboh (2008) on Clementine reported that V.C. were increased by boron applications. Also, Baghdady et al. (2014) on Valencia orange, spraying both of calcium and boron improved fruit quality. On the contrary, inadequate levels of calcium and boron will accelerate fruit ripening and metabolic process, thereby low level of TSS and sugar content (Muazzam et al., 2012; Ferguson and 1984).

RECOMMENDATION:

Obtained results of this study recommended spray both of calcium and boron in combination as pre-harvest treatment to improve growth performance and fruit quality. All these effects may be attributed to role of:-

1- Boron is essential element in several processes for instance protein synthesis, transport of sugars and carbohydrate (Ferguson, 1984). Moreover, Muazzam et al. (2012) reported that, boron feasibility increases calcium metabolism which deceases respiration rate that reflect on accumulation of sugar and TSS in fruit.

2- Calcium in blocking physiological disorders, respiration rate decreasing, delaying development and decaying fruit tissues (Magee et al., 2002).

Further studies will look forward to emphasis the benefit of this study concerning with role of calcium and boron application in improving fruit quality and increasing shelf-life of fig fruit.

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