Egypt. J. Hort. **Vol. 44,** No.1, pp.119- 126 (2017)

Effect of Different Treatments of Calcium and Boron on Productivity and Fruit Quality of Navel Orange Fruits

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PRODUCTIVITY, fruit setting, fruit drop, yield and fruit quality of Washington navel orange (*Citrus sinensis* L. Osbeck) trees in response to spraying both calcium chloride ($CaCl_2$) at 0.5, 1.0, 1.5 and 2.0% and boric acid (H_3BO_3) at 0.050, 0.075, 0.1 % and 0.2% were evaluated during two successive seasons, 2014 and 2015 at El-Kanater El-Khayria research station, El-QalyubeiaGov., Egypt. The experimentwas designed as randomized complete block design with three replications. Results showed that most of boron treatments and the high concentrations ofcalcium applications were effective inimproving thefinal fruit set %, yield (kg), fruit quality as well as average fruit weight, average fruit volume, TSS (%)and vitamin C ascompared to the control. They also, led to significant decrease in June-drop (%) and juice acidity (%). However, the best results with regard to fruit setting, yield and fruit quality were significantly obtained due to spraying trees with 0.2% boric acid followed by 2.0% Calcium chloride treatments. So, we may recommend to apply both of these treatments to maximize productivity and the net profits.

Keywords : Calcium, Boron, Washington navel orange, Fruit quality, Yield.

Introduction

Citrus is ranked the primary fruit crop in Egypt. It is the most economic fruit crop for local consumption and export. Washington navel orange is one of the most popular citrus varieties in Egypt, for its delicious taste and nutritional value, besides being rich in vitamin C and minerals. Its cultivated area reached 449266 feddans producing 4644450 tons of fruits annually according to The Annual Book of Agricultural Statistics, Cairo (2016). However, itsmoderate and/or low productivity of grownorchards is considered major and critical problem in Washington navel orange orchards. The lack of balanced nutrition is considered one among other factors which affect the growth, fruit setting and yield.

Applications of calciumand boron may partially help to over-come this problem.The application of calcium inhibits fruit abscission and delays its senescence development (Poovaiah and Leopold,1973), increase fruit pull force and firmness (Faust, 1975).

On the other hand, boron plays a major role in enhancing cell division, biosynthesis of carbohydrates and proteins, flowers pollination and fertilization and the movement of (Nijjar, 1985). It plays an important role in improving fruit setting through encouraging germination and growth of pollen grains (Chiu and Change 1985).

Regarding the similarity of B functions to other plant nutrients, Ca-B relationship is outstanding. Both elements play an important role in cell wall metabolism and are required for auxin transport process (Dela-Fuente et al., 1986). Additionally, B is involved in physiological and biochemical processes inside the plant cell, altering the concentration and translocation of nutrients (Tariq and Mott, 2007).

The purpose of this study wasto assistthe effectiveness of spraying calcium, and boron onthe productivity andfruit quality of Washington navel orange fruits.

Materials and Methods

This study was carried out during two successive seasons (2014 & 2015) on 20 year- old Washingtonnavel orange trees (*Citrus sinensis* L. Osbeck) grown in the Experimental Farm at

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DOI: 10.21608/ejoh.2017.1200.1013

El-Kanater El-Khayria Res. Sta., El-Qalyubeia Gov., Egypt. The trees were planted at 5 × 5 m and irrigated with surface irrigation system. Fifty four trees, as uniform as possible, were selected and sprayed with nine foliar applications. The treatments were as follows:

Control (Spraying with tapwater)
- 0.5% Calcium chloride (CaCL2)
- 1.0% Calcium chloride ($CaCL_2$)
- 1.5% Calcium chloride ($CaCL_2$)
- 2.0% Calcium chloride ($CaCL_2$)
- 0.050% Boric acid (H_3BO_3)
- 0.075% Boric acid(H_3BO_3)
- % Boric acid (H_3BO_3)
- 0.2% Boric acid (H_3BO_3)

A randomize complete block design with three replicates; two trees per each wereused. Treeswere fully sprayed with the specified solutions using a hand pressure sprayer three times a year i.e. at three weeks before flowering (2nd week of Feb.), just after fruit setting (1st week of April) and at one month later (1st of May).

Measurements and Determinations:

Vegetative growth
- Shoot length (cm).
- Shoot diameter (cm)
- Leaf area (cm^2) was measured (using mature leaf at the second week of September)using laserleaf area meter (model CI-203CA from CID. Inc. company).

Fruit set and drop (%)

The final fruit set (%),June drop (%)and pre-harvest fruitdrop (%) were estimated at 15 November during bothseasons as follows:

$$\text{Final fruit set (\%)} = \frac{\text{Total number of fruits}}{\text{Total number of flowers}} \times 100$$

$$\text{June drop (\%)} = \frac{\text{Number of dropped fruits}}{\text{Total number of fruits}} \times 100$$

$$\text{Pre-harvest fruit drop (\%)} = \frac{\text{Number of dropped fruits under trees}}{\text{Total number of fruits on tree}} \times 100$$

Yield components

Fruit yield wasrecorded at harvest time (December) in both seasons expressed as number of fruits/tree and weight of fruits (kg/tree).

Fruit quality

Six fruitsamplesfor each treatment at harvest time (one/ each tree) in both seasons were taken in order to determine fruit quality; physical properties i.e. fruit weight (g) and fruit size (cm^3) and chemical properties i.e. total soluble solids (TSS) using Carl Zeiss hand referactometer, total acidity as (g) of unhydrous citric acid, TSS/acid ratio and Vitamin C as mg ascorbic acid were determined and estimated per mg /100 ml juice, according to A.O.A.C. (1965).

Leaf mineral contents were determined as follows:

On March of both seasons, twenty spring shoots from all over the outer circumference of each treated tree were labeled for leaf samples. From each replicate, a sample of about 60 leaves was taken in the first week of October (each year) for the chemical analysis.

The collected leaf samples were washed with tap water, rinsed three times with distilled water and then oven dried at 70 ^{0}C to a constant weight. Leaf dried materials were ground in a stainless steel rotary knife with a mill 20 mesh.

The dried ground samplesweredigested with sulphuric acid and hydrogen peroxide. Suitable aliquots were taken for the determination of N, P, K, Ca, Fe, Zn and Mn according to Chapman (1960) and Chapman and Pratt (1978).

Macronutrients
- Total nitrogen percentage in dry leaf samples was determined using the microkjeldahal method as described by A.O.A.C. (1965).
- Phosphorus was determined using ammonium venedate method as described by Chapman and Pratt (1978).
- Potassium was measured against a standard using Carlzesis Jena Flame Photometer.
- Calcium and magnesium were determined according to the wet aching method technique as reported by Jackson (1967), by using atomic absorption Spectorphotometer.

Micronutrients
- Zinc was determined according to Chapman (1960) directly in the original solution using atomic absorption spectorphotometer.
- Fe and Mn were determined according to Evenhuis and De Waard (1980).

Statistical analysis

Experimental design was a complete randomized block design according to Snedecor and Cochran (1980). The averages were compared using New L.S.D. at 5%.

Results

Vegetative growth

Shoot length (cm)

Data presented in Table1 obviously reveal that, most of calcium and boron treatments significantly increased shoot length when compared to thecontrol in both seasons. Boric acid (0.2%) treatment showed the highest effect (13.04 and 12.88 cm) in both seasons, respectively. However control treatment had the lowest values (9.65 and 9.01cm) in both seasons, respectively.

Shoot diameter (cm)

Data presented in Table 1 obviously indicate that Washington navel orange shoot diameterwas significantlyaffected by Ca and B treatments when compared to control in both seasons. The best treatment in this regard was obtained by spraying B at 0.2 % in both seasons 9.87 and 9.06 cm, followed by spraying with Ca at 2% resulted at (9.25 and 8.71cm), respectively.

Leaf area (cm^2)

Data obtained in Table 1 show that all treatments resulted in a slight increase with lack of significance for the majority of treatments as compared to control during the two study seasons. Nevertheless, application of B at (0.20%) wasmore effective (126.58 and 123.79), than Ca at (2.0%) resulting in 121.99 and 118.91 cm^2in the two seasons, respectively.

Fruit set and drop

Final fruit set percentage

Concerning the final fruit set percentage recorded in both seasons (Table 2) the dataobviously showedthat fruit set percentage was improved in treated trees compared with the control. The best functional treatments in this regard were foliar sprays of B (0.2% Boric acid) and Ca (2.0% $CaCL_2$) in both seasons where the results were (4.48 & 4.18% and 3.22 & 3.20%) in both seasons, respectively.

Fruit June drop percentage

According to data presented in Table 2 fruit June drop was decreased by the higher compared to control in both seasons.The best result was obtained by foliar sprays of 0.2% Boric acid treatment (89.62% and 88.73 %) followed by 2.0% $CaCL_2$ one (90.01% and 89.66 %) in both seasons, respectively.

Pre-harvest fruit drop percentage

Data presented in Table 2 disclosedthat the pre-harvest fruit drop percentage was positively affected bymost of treatments compared with the control in both seasons. Data revealed also that, the lowest value wasobtained by foliar sprays of boric acid at 0.2%.

Yield components

Fruits number/tree

It is clear from the data presented in Table 3 that foliar sprays of B at 0.2 % Boric acid followedby Ca (2% $CaCl_2$) resulted in the highest number of fruit per tree. Also, average number of fruits/ tree was enhanced by most of treatments compared tocontrol trees. The best results, in this regard, were obtained by foliar B at 0.2 % (302.58 and 289.46) in both seasons, respectively.

Yield/tree (kg)

Data presented in Table 3 declared that yield (kg)/tree was significantly increased in all foliar sprays of either of B or Ca treatments with lack of significance in general as compared tothe control. The most effectivetreatment was foliar sprays

TABLE 1. Effect of different treatments of calcium and boron on shoot length (cm), shoot diameter (cm), leaves number/ shoot and leaf area (cm^2)of Washington navel orange trees during 2014 and 2015seasons.

Treatments	Shoot length (cm)		Shoot diameter (cm)		Leaf area/shoot (cm^2)	
	2014	2015	2014	2015	2014	2015
Control	9.65	9.01	7.36	6.98	112.68	108.06
0.5%$CaCL_2$	10.79	10.14	8.34	7.98	113.50	108.78
1.0%$CaCL_2$	11.08	11.54	8.43	8.08	113.90	112.97
1.5%$CaCL_2$	12.16	12.17	9.47	8.64	120.10	118.12
2.0%$CaCL_2$	12.69	12.58	9.25	8.71	121.99	118.91
0.050% Boric acid	11.43	11.54	9.55	8.54	116.16	115.09
0.075% Boric acid	12.05	12.14	9.61	8.69	120.76	120.34
0.1 % Boric acid	12.77	12.64	9.73	8.83	123.05	120.78
0.2% Boric acid	13.04	12.88	9.87	9.06	126.58	123.79
New LSD 5%	1.52	1.21	1.13	1.09	8.21	9.07

TABLE 2. Effect of different treatments of calcium and boron on final fruit set (%), June and pre-harvest fruit drop (%) of Washington navel orange trees during 2014 and2015 seasons.

Treatments	Final fruit set (%)		June drop (%)		Pre-harvest fruit drop (%)	
	2014	2015	2014	2015	2014	2015
Control	2.12	2.08	93.18	92.65	3.67	3.38
0.5%$CaCL_2$	2.99	2.86	92.01	91.13	3.15	2.94
1.0%$CaCL_2$	3.11	3.06	91.74	90.65	3.03	2.89
1.5%$CaCL_2$	3.16	3.13	90.14	89.95	2.91	2.83
2.0%$CaCL_2$	3.22	3.20	90.01	89.66	2.89	2.76
0.050% Boric acid	3.02	2.78	91.64	90.56	3.03	2.97
0.075% Boric acid	3.32	3.11	91.03	89.94	2.93	2.83
0.1 % Boric acid	4.23	3.87	90	89.03	2.85	2.8
0.2% Boric acid	4.48	4.18	89.62	88.73	2.76	2.74
New LSD 5%	0.95	0.87	1.76	1.64	0.61	0.54

TABLE 3. Effect of different treatments of calcium and boron onfruits number/ tree, yield (kg)/ tree, fruit weight (g) and fruit volume (cm^3) of Washington navel orange trees during 2014 and 2015 seasons.

Treatments	Fruits number/ tree		Yield (kg)/ tree		Fruit weight (g)		Fruit volume (cm^3)	
	2014	2015	2014	2015	2014	2015	2014	2015
Control	275.10	269.40	64.35	61.85	233.90	229.60	235.2	235.4
0.5%$CaCL_2$	278.97	274.90	66.02	64.22	236.67	233.63	242.9	240.1
1.0%$CaCL_2$	281.23	278.35	69.07	66.80	245.59	240.00	252.4	246.8
1.5%$CaCL_2$	289.32	283.93	72.67	69.67	251.17	245.39	258.9	252.4
2.0%CaCL2	292.41	284.56	75.62	72.14	258.62	253.53	265.8	260.4
0.050% Boric acid	277.42	270.54	65.87	63.97	237.45	236.47	244.3	243.7
0.075% Boric acid	284.28	277.41	70.06	69.49	246.43	250.49	262.1	258.1
0.1 % Boric acid	289.61	285.66	74.36	72.23	256.76	252.84	264.6	260.2
0.2 % Boric acid	302.58	289.46	79.80	75.04	263.72	259.24	271.4	267.0
New LSD 5%	8.51	9.38	1.80	1.60	4.70	4.50	14.8	14.6

of B (0.2 % Boric acid) 79.80 and 75.04 kg, respectively. In the second season, average yields - as weight per tree- significantly increased by all foliar spray treatments compared tocontrol. The lowest values were attainedwith thecontrol trees (64.35 and 61.85) in the two seasons, respectively.

Fruit quality

Physical properties

The obtained data in Table 3 indicated that, foliar spraying with B or Ca enhanced average fruit weight and volume as compared with control treatment in both seasons. The data also showed that, Boric acid at the treatment at 0.2 %followed by $CaCL_2$ at 2.0%, achieved significantly the highest values of average fruit weight and volume compared to control treatment in both seasons.

Chemical properties

Data in Table 4 demonstrated that all Catreatments had a minor positive effect concerning TSS% and vitamin C while, it had noclear trend regardingTSS/acid ratio.

On the other hand,Boric acid at 0.2 %was more effective in increasing TSS %, and vitamin C content than all other treatments.Control treatment had the lowest TSS % values for both seasons, while Boricacid at 0.2 % achieved the highest figures in this concern.

Leaf minerals composition

Macronutrients

Concerning leaf N%, P%, K% and Ca% and M, the obtained data in Table 5 show thatfoliar spray with Ca had observable influence concerning leafmineral content especially lower concentrations. Whereas, Boric acid at 0.2% significantlyhave resulted in the highest values compared to control treatment in two seasons.

Micronutrients

Data illustrated in Table 6 showed that, B gave highly significant increase in leaf Fe, Zn and Mn contents in both seasons.The lowest value was found with the control trees in the two seasons.

Feasibility study

To evaluate the economic return for the examined treatments, a feasibility study was made up to settle onthe superlative treatment which had the best profit. Figures illustrated in Table 7 showed that, 0.2 % boric acid treatments achieved the uppermost profits and the highest annualreturn of 16% on investment perfeddan. It worth to mention that, despite that the calcium price was less than boron but, its effective concentrations were nearly ten times of the boron ones which reflected in increasing the coast and consequently reduced the net profit for it.

TABLE 4. Effect of different treatments of calcium and boron on TSS, total acidity, TSS/acid ratio and vitamin C (mg/100ml juice) of Washington navel orange fruits during 2014 and 2015 seasons.

Treatments	T.S.S (%)		Total acidity (%)		TSS/acid ratio		Vitamin C (mg /100ml juice)	
	2014	2015	2014	2015	2014	2015	2014	2015
Control	12.1	12	1.32	1.22	9.15	9.81	46.6	45.7
0.5%$CaCL_2$	12.4	12.3	1.33	1.24	9.29	9.90	47.6	46.7
1.0%$CaCL_2$	12.5	12.5	1.32	1.23	9.44	10.14	48.3	47.6
1.5%$CaCL_2$	12.7	12.7	1.32	1.23	9.63	10.33	49.5	48.7
2.0%$CaCL_2$	12.8	12.7	1.32	1.23	9.67	10.32	49.9	49.7
0.050% Boric acid	12.5	12.6	1.33	1.25	9.40	10.06	48.9	48
0.075% Boric acid	12.7	12.8	1.32	1.29	9.62	9.95	50.2	49.6
0.1 % Boric acid	12.9	12.8	1.31	1.23	9.86	10.44	51.4	52
0.2 % Boric acid	13.0	13.0	1.30	1.22	9.97	10.64	54.8	53.9
New LSD 5%	0.62	0.64	0.14	0.08	0.43	0.31	3.1	3.6

TABLE 5. Effect of different treatments of calcium and boron on N%, P%, K% and Ca %of Washington navel orange leaf mineral contents during 2014 and 2015 seasons.

Treatments	Leaf N (%)		Leaf P (%)		Leaf K (%)		Leaf Ca (%)		Leaf Mg (%)	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Control	1.83	1.80	0.15	0.14	1.19	1.17	1.88	1.85	0.62	0.6
0.5%$CaCL_2$	1.97	1.96	0.19	0.18	1.29	1.26	1.98	2.01	0.65	0.62
1.0%$CaCL_2$	2.01	1.99	0.19	0.19	1.35	1.33	2.07	2.06	0.67	0.66
1.5%$CaCL_2$	2.00	2.07	0.20	0.20	1.39	1.37	2.10	2.09	0.68	0.67
2.0%$CaCL_2$	2.03	2.02	0.20	0.21	1.47	1.43	2.11	2.13	0.70	0.69
0.050% Boric acid	2.02	1.97	0.18	0.19	1.30	1.27	1.99	2.01	0.64	0.63
0.075% Boric acid	2.10	2.04	0.19	0.20	1.39	1.36	2.06	2.08	0.67	0.65
0.1% Boric acid	2.14	2.10	0.21	0.21	1.45	1.41	2.09	2.10	0.69	0.68
0.2% Boric acid	2.16	2.12	0.22	0.21	1.47	1.44	2.12	2.13	0.71	0.70
New LSD 5%	0.17	0.19	0.05	0.05	0.17	0.14	0.19	0.17	0.06	0.05

TABLE 6. Effect of different treatments of calcium and boron onleaf Mg% and leaf (Fe,Zn and Mn) of Washington navel orange leaf mineral contents during 2014 and 2015 seasons.

Treatments	Leaf Fe (ppm)		Leaf Zn (ppm)		Leaf Mn (ppm)	
	2014	2015	2014	2015	2014	2015
Control	83	80.32	67.51	66.14	57.38	54.83
0.5%$CaCL_2$	83.72	84.55	69.00	69.35	59.80	59.85
1.0%$CaCL_2$	86.48	84.64	75.81	70.84	64.44	60.72
1.5%$CaCL_2$	90.29	86.40	75.70	74.68	64.89	64.54
2.0%$CaCL_2$	90.20	88.32	76.50	74.63	65.12	65.85
0.050% Boric acid	84.55	81.70	71.25	68.40	64.60	63.65
0.075% Boric acid	87.40	86.45	75.05	74.10	67.45	73.15
0.1% Boric acid	94.05	91.20	78.85	76.00	71.89	72.80
0.2 % Boric acid	96.90	94.05	86.45	80.99	75.65	73.87
New LSD 5%	8.12	8.34	8.86	9.10	8.63	8.44

TABLE 7. Feasibility study for different treatments of calcium and boron onWashington navel orangeyield revenue.

Treatments	Yield /Feddan (Ton)			*Yield return/Feddan (pound)			Treatment return/F (pound)			**Treat. Coast (pound)	Treatment profit (pound)					
	2014	2015	AVG.	2014	2015	AVG.	2014	2015	AVG.		2014	2015	AVG.	2014	2015	AVG.
Control	10.8	10.4	10.6	13405	12885	13145	0	0	0	0	0	0	0	0	0	0
0.5 %$CaCL_2$	11.1	10.8	10.9	13753	13378	13566	348	494	421	390	-42	104	31	-0.3	0.8	0.2
1.0 %$CaCL_2$	11.6	11.2	11.4	14389	13916	14152	983	1,031	1,007	570	413	461	437	2.9	3.3	3.1
1.5 %$CaCL_2$	12.2	11.7	12.0	15139	14514	14826	1,733	1,629	1,681	750	983	879	931	6.5	6.1	6.3
2.0 %CaCL2	12.7	12.1	12.4	15753	15028	15391	2.348	2,144	2,246	930	1418	1214	1316	9.0	8.1	8.5
0.05 % Boric acid	11.1	10.7	10.9	13722	13326	13524	317	442	379	237	80	205	142	0.6	1.5	1.1
0.075 % Boric acid	11.8	11.7	11.7	14595	14476	14536	1,190	1,592	1,391	250.5	939	1341	1140	6.4	9.3	7.8
0.1 % Boric acid	12.5	12.1	12.3	15491	15047	15269	2,085	2,162	2,124	264	1821	1898	1860	11.8	12.6	12.2
0.2 % Boric acid	13.4	12.6	13.0	16624	15632	16128	3.219	2,748	2,983	318	2901	2430	2665	17.4	15.5	16.5

*Washington navel orange/Ton: 1245 pounds

**Treatment Coast:included: material, spraying and labor coast where, Calcium Kg.:20 E. pounds Boron Kg.: 30 pounds

Discussion

The results obtained from the spray of Ca and B treatments showed the role of both calcium and boron on the vegetative growth parameters, fruit set (%), different stages of fruit drop (%), yield and fruit quality of Washington navel orange trees. In this respect, in view of the preceding results it appears that foliarsprayswith boron have positive effects on the number of pollen tubes that successfully reached the ovule and on ovule viability significantly increased the number of flowers with double pistils Lovatt (1999). Moreover, boron stimulates ammonium assimilation in leaves and consequently increases protein concentration with greater boron dosages, supports assumption of a direct positive effect of boron on ammonium ion assimilation, alsoboron hada positive effect on the foliar activities of the enzymes involved in assimilating the $NH4^+$ as glutamine synthetase, glutamate syntheses, glutamate dehydrogenase, and phosphoenolpyruvate carboxylase enzymes López-Lefebre et al. (2002). Boron could acts in the reaction medium by altering the conformation of the enzyme or by augmenting the affinity of some substrate or cofactor for the enzyme.

Still, Calcium is a divalent cation that is extremely important in maintaining the strength of stems and stalks of plants. This mineral also regulates the absorption of nutrients across plasma cell membranes. Calcium functions in plant cell elongation and division, structure and permeability of cell membranes, nitrogen metabolism, and carbohydrate translocation;thus it is a significant factor in inflorescence and flower formation and fruit quality (White, 2000).

In addition, it could be noted from previous data that boron applications had upmost calcium ones in most comparable parameters, which may be due to thatthe role of B maximized the Ca function by keepingit in a soluble form within the plant on a tissue basis rather than on a cellular basis (Wallace, 1961). Besides, it is thought to have a favorable influence on the absorption of cations particularly calcium, to have retarding influence on the absorption of anions and to have an essential part in carbohydrate and nitrogen metabolism (Batey, 1971).

Similar tendency was found with the application of B as borax or boric acid source (Kodua, 1980 on mandarin, Singh and Singh 1981 on mandarin, El-Hagab et al., 1983 on Navel orange and Balady mandarin trees, Ahmed et al., 1991 on Balady mandarin and Ahmed et al., 1996 on Balady mandarin). Also, Hegab et al., 2003 reported that spraying borax or boric acid on Washington navel orange trees at 0.025 to 0.2 caused a remarkable promotion in leaf area, length and diameter of shoot in the spring growth cycle and promoted the percentage of fruit setting. They found that using boric acid caused slight promotion on the growth. Also, Habasy et al. (2016) found that application for both Ca and B had an announced effect on growth, yield, percentages of N, P and K in the leaves, leaf content of pigments and nutrients owing to spraying the trees with a mixture of chelated-Ca at 0.03 and chelated-B at 0.025% three times (1st week of March, last week of April and 3rd week of May).

These results are also partially agreed with the findings of El-Shobaky and Mohamed (2000) and Aly et al. (2015) by foliar application with calcium. Deficiency of Ca and B had unfavorable effects on fruit quality (Nijjar, 1985). Also, Hegab et al. (2003), found that using boric acid caused slight promotion on fruit quality compared to borax.

Moreover, it has been reported that, growth, flowering, fruit setting, yield and fruit quality in citrus are positively affected by the application of B in the form of borax or boric acid Qin and Qin 1996 on orange; and Abd-El-Wahab, 1999 on Washington navel orange).

Generally, we may conclude that the figures attained from this study pointed out to that;spraying trees with Boric acid at 0.2 % achieved the best results and the utmost profit followed by spraying calcium at 2%. So,we may recommend applying both of treatments to gain more than either of their return; over and above get the advantages of boron affect on calcium mechanism in plant.

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(*Received* 4/ 6/ 2017;
accepted 8/ 8/2017)

تأثير المعاملات المختلفة للكالسيوم والبورون على الإنتاجية وصفات الجودة والقدرة التخزينية لثمار البرتقال أبو سرة

علي رزق فرحات هيكل ، مجدى عبد الفتاح ابراهيم و رضا عبدالله عبد العزيز
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تم تقييم الإنتاجية، عقد وتساقط الثمار،المحصولوصفات الجودة لأشجار البرتقال واشنطن أبوسرة رشاًبكلوريد الكالسيوم بتركيز ٠,٥ ، ١,٠ ، ١,٥ ، ٢,٠٪ وحمض البورون بتركيز ٠,٠٥٠، ٠,٠٧٥، ٠,١ ، ٠,٢٪ خلال موسمين متتالين ٢٠١٤ ، ٢٠١٥ في محطة القناطر الخيرية للبحوث، محافظة القليوبية، مصر. وقد صممت التجارب على أنها تصميم كتلة كاملة عشوائية مع ثلاثة مكررات. وأظهرت النتائج أن أغلب معاملات البورون والتركيزات العالية للكالسيوم كانت فعالة في تحسين النسبة المئوية لعقد الثمار، والمحصول، وجودة الثمار كذلك متوسط وزن الثمرة (جم) ، متوسط حجم الثمرة (سم٣) ، النسبة المئوية للمواد الصلبة الكلية الذائبة و فيتامين (ج) مقارنةً بمعاملة الكنترول. كما أدت هذه المعاملات إلى انخفاض معنوي في النسبة المئوية لتساقط يونيو في الثمار وكذلك النسبة المئوية لحموضة العصير مقارنة بمعاملة الكنترول. تم الحصول على أفضل النتائج متمثلة فيعقد الثمار والمحصول وجودة الثمار الى جانب تحقيق اعلى ربحية من رش أشجار البرتقال ابوسرة واشنطن بحمض البوريك ٠,٢٪ تليها معاملة الرشبكلوريد الكالسيوم ٢,٠٪.وبناء على هذا يمكن التوصية برش الأشجار بكلا المعاملتان لتحقيق أعلى انتاجية واكبر معدل من الربحية.