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Increasing Fruit Set, Yield and Fruit Quality of "Canino" Apricot Trees under Two Different Soil Conditions

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Authors' contributions

This work was carried out in collaboration between both authors. Authors NMT and HMS designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript and managed literature searches. Authors NMT and HMS managed the analyses of the study and literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

The present investigation was carried out during 2012 and 2013 on 'Canino' apricot trees budded on seedling rootstock at two private orchards located at El-Khatatba district (as sand soil) and El – Neanaaia village, (as clay soil) Menoufia Governorate, Egypt. Trees were sprayed four times at the start of growth in the 3rd week of February(swelling bud stage), at flowering (balloon stage)in the 1st week of March, just after fruit setting in the first week of April and month before harvest with three sources of calcium, Inca (Ca & Zn) at two concentrations (1&2 cm^3), Klover Calbora (Ca & B chelated on hepta glouconic acid) at two concentrations (1&2 cm^3) and Calciven (soluble $CaCl_2$ chelated on amino and organic acids & 5% B) at two concentrations (1&2 cm^3). Results showed that, higher concentration of the studied treatments was mostly more effective than low one. Clay soil supported better fruit set, yield, leaf chlorophyll, Ca, Zn, B and TSS while sand soil encouraged fruit weight, size, dimensions flesh thickness and firmness but also decreased fruit drop.

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Keywords: Apricot; calcium; zinc; boron; fruit set; yield; fruit quality; sand and clay soil.

1. INTRODUCTION

"Canino" apricot (*Prunus armenica* L.) is one of the most popular and important stone fruit grown in Egypt. Several factors were studied to decrease fruit abscission and improve yield and fruit quality. One of the most important factors is spraying calcium element which enhances fruit set, reduces fruit drop, increases yield and fruit quality essentially combined with boron.

Calcium (Ca) is the most important mineral determining the quality of fruit. Calcium sprays applied to fruit during the growing season may reduce the incidence of certain fruit disorders and improve fruit quality [1]. Responses to calcium sprays are not predictable from calcium levels in soil or leaves. In addition, Stebbins et al. [2] and Eissa et al. [3] mentioned that calcium functions appeared as a cross and linkage of the middle lamella, which binds cells together. It is also needed in enzymatic reactions, provides the balance of anions and cations in the plant and plays an important role in the stabilization of cell membranes. Researches reported that pre or post harvest application of calcium extended the shelf-life by maintaining firmness, reducing respiration rate and increasing marketability of fruits.

As regard to boron element, it plays an important role in protein synthesis, sugar transport, hormone, catabolism and growth of pollen tube [4]). Boron improved chemical fruit quality [5]. Boron may be applied at any time but is more effective in improving blossom quality and fruit set if applied shortly before full bloom. Sprays can also be applied early during the growing season or postharvest while the leaves are still green and active. Higher maintenance rates may be required for orchards planted on very sand or calcareous soils [6]. Hassan et al. [7] showed that spraying boron caused a remarked promotion in leaf mineral status, yield and fruit quality compared with the control. Using boron in descending order was very effective in improving the growth, nutritional status, fruit quantity. Also, suggested to be beneficial in improving the growth, nutritional status, and yield and fruit quality of "Canino" [8]. Kavvadias et al. [9] recommended that pre-harvest spray of Ca + B at flowering, fruit set and fruit growth is useful for reducing fruit cracking and *Monilinia laxa* infections and improving fruit quality. They added more research still need to be conducted to investigate the long term effect of B and Ca applications on peach variety Andros'.

Zinc is essential element for crop production and optimal size of fruit, also it is required in carbonic enzyme which present in all photosynthetic tissues and required for chlorophyll biosynthesis [10]. Zn have main role in synthesis of proteins, enzyme activating, metabolism of carbohydrates. By fertilizers contain zinc and other micronutrients; performance on quality of crops is increasing [11].

Recently, Keshavarazl et al. [12] reported that spraying Persian walnut with boron and zinc at 174 and 105 mg/L, recorded the highest values in pollen germination, fruit set ,nut weight, kernel percent, nut and kernel length and chlorophyll. In addition, Sarrwy et al. [13] indicated that spraying date palm inflorescence with both boric acid and/or calcium nitrate had a significant effect on fruit set, yield and fruit physical and chemical characteristics. Polyamines are low molecular weight aliphatic amine compounds existents at every place in plants, animals and bacteria. They have been associated with growth and tissue differentiation [14]. The influence of polyamines in increasing fruit set has been observed in apple and pear where they enhanced pollen tube, ovule penetration and delayed ovule senescence without affecting flower ethylene production [15].

The aim of this research is to study the action of spraying Ca^{++} from different sources (Ca O or Ca Cl_2) and combined with different elements like B, Zn and N to achieve the possibility of improving fruit set, yield and fruit quality of Canino apricot trees through application of Inca, Calbor and Calciven compounds at different concentrations under two types of soil.

2. MATERIALS AND METHODS

The present investigation was conducted during the two growing successive seasons of 2012 and 2013 on "Canino" apricot (*Prunus armeniaca* L.) trees in a private orchard at El Khatatba (as sand soil) and El-Neanaaia (as clay soil) at El Monuofia Governorate. Soil characters are listed in Table (1).

Table 1. Chemical properties of the studied soils

Chemical analysis:-

Soil no.	Sp	pH 1-2.5	Total $CaCO_3$ %	EC Ds/m-1	O.M%	Cations (mmolc L -1)				Anions (mmolc L -1)			
						Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	CO_3^{-}	HCO_2^{-}	Cl^{-}	SO_4^{-}
1-El Khatatba	22	8.04	1.49	1.56	0.35	3.24	2.81	7.61	0.24	2.67	1.21	9.22	3.47
2-El-Neanaaia	55	7.70	2.90	1.52	1.70	3.99	3.00	6.41	0.60	4.90	1.60	8.31	4.09

Macro-nutrients and micro- nutrients (mg /kg soil)

Soil no.	N	P	K	Fe	Mn	Zn
1- El Khatatba	75	7.5	110	2.67	0.30	0.8
2-El – Neanaaia	100	5.5	122	4.90	1.00	1.8

Selected trees were fifteen years old, grafted on Balady apricot seedlings and planted at 5 x 5 meters apart, nearly similar in growth vigor and fruiting, free from any visual disease symptoms and receiving regularly the recommended orchard management. Three sources of calcium, Inca (Ca & Zn) at two concentrations 1 & 2 cm^3/L. Klover Calbor (Ca & B chelated on heptaglouconic acid) at two concentrations 2 & 3 cm^3/L. and Calciven (soluble Ca chelated on amino acid and organic acid and B) at two concentrations 1 & 2 cm^3/L. On clay soil treatments were applied as a foliar four times at the start of growth in the 3rd week of February(swelling bud stage), at balloon stage in the 1st week of March, just after fruit set in the last week of March and month before harvest. While on sand soil all stage were earliest with 3 or 5 days than on clay soil .The experimental design was completely randomized, with seven treatments in three replicates consisting of five trees each. The applied treatments were as follows:

- 1 cm^3/L Inca (6%Ca &1%Zn).
- 2 cm^3/L Inca (6%Ca & 1%Zn).
- 2 cm^3/L Calbor (9% Ca O &1%boron &5% hepta glouconic acid).
- 3 cm^3/L Calbor (9% Ca O &1%boron & 5% hepta glouconic acid).
- 1 cm^3/L Calciven (15% Ca Cl2&1% boron chelated on amino acid and organic acid).
- 2 cm^3/L Calciven (15% Ca Cl2&1% boron chelated on amino acid and organic acid).
- Tap water as control.

Furthermore, to evaluate the efficiency of the tested treatments on tree growth, fruiting and fruit quality, the following measurements were carried out:-

Eight branches selected around tree were chosen and labeled before spraying for determine different obtained data in both seasons.

1- Flowering and Fruiting:

Eight branches, in the different sides of each tree were tagged for determining the fruit set percentage, fruit drop and yield.

Fruit set was calculated in relation to the total number of flowers and then the percentages were calculated as follow:

Fruit set (%) = No. of developing fruitlets x 100 /Total No. of flowers
Fruit drop (%) = No. of fruitlets at set - No. of fruit at picking time ÷ No of fruitlets at set × 100

Fruits were collected at maturity stage late of June from each tree of various replicates.

2- Yield and fruit quality:-
2-1 Yield (kg/tree)

Fruits were collected at maturity stage late of June from each tree of various replicates and yield weight (kg/tree) was estimated by multiplying the number of fruits with average fruit weight.

2-2 Fruit physical properties:-

Twenty fruits from each tree under study were chosen for determining the following:-

2 – 2-1 Average weight of fruit (gm).
2- 2-2 Average fruit volume (ml).
2 - 2- 3 Average fruit length (cm).
2- 2-4 Average fruit diameter (cm).
2-2-5 Fruit flesh thickness (cm).
2-2-6 Fruit firmness was estimated as Ib/inch2 using the Magness and Taylor (1925) pressure tester of 5/16 inch plunger.
2-2-7According to the monetary study of fruit yield it can be calculated the farm gate price of the final product as follow:

a. Fruits volume less than 40 ml. = 1 LE/Kg.
b. Fruits volume from 40 - 45 ml. = 1.5 LE/Kg.
c. Fruits volume more than 45 ml. = 2 LE/Kg.

The equation of monetary value = yield × price (LE/kg)

2- 3 Chemical properties:-

2-3-1 Total soluble solids (TSS) was determined by a hand refractometer,
2-3-2 Acidity of fruit juice was determined (as malic acid) by titration with 0.1 normal sodium hydroxide with phenolphthalein as an indicator, according to [16].

3-Determination of leaf chemical composition:-

Leaf chemical content were determined in mid August of both seasons. Samples of 30 leaves /tree were taken at random from the previously tagged shoots of each tree and were tested to leaf chlorophyll content using Minol to chlorophyll meter SPAD-502) (Minol to camera. Co, LTD Japan) at the field in mid- August. The average of ten readings was taken on the middle of leaves from all over the tree circumference, according to [17]. Leaf samples were washed with tap water and distilled water twice, dried at 70ºC to a constant weight and then ground. The ground samples were digested with sulphoric acid and hydrogen peroxide according to [18]. Total nitrogen was determined calorimetrically according to [19,20], respectively. Ca and Zn were determined by Perking –Elmer Atomic Absorption Spectrophotometer model 2380, according to [21,22] and colorimetry using the azomethine H spectro photometric method for B [23]. Boron was determined calorimetrically by the carmine method according to [24]. The concentration of N, Ca were expressed as percent %, while Zn and B were expressed as part per million (PPM) on dry weight basis.

Data were statistically analyzed in split-split plot design according to the method of [25], Duncan at 5% level was used for comparison between means of each treatment.

3. RESULTS AND DISCUSSION

1-Flowering and Fruiting:

1-1 Fruit set %:

Regarding the effect of spraying different sources of Ca under investigation study on fruit set, Table 2. it is cleared that spraying with Inca and Calciven had a positive effect on fruit set than control in both seasons. Inca (at high and low concentrations) has followed by Calciven at both concentrations recorded the highest percentages of fruit set in both seasons. With respect to type of soil, clay soil conditions supported "Canino" apricot trees to achieve higher fruit set percentages (21.74 and 18.04%) through 2012 and 2013 seasons respectively. Moreover, trees on clay soil with the highest level concentration of treatments recorded the highest percentages of fruit set in both seasons. The highest significant interaction was noticed by spraying Inca (2 cm^3/L) for the two types of soil.

Obtained data go in line with Pandy et al. [26] that showed that protein synthesis has declined by zinc deficit. One of the sites of protein synthesis is pollen tube; the amount of zinc in their tip is 150 micrograms/gram of dry matter. In addition zinc contributes on the pollination by impact on pollen tube formation.

Additionally, foliar application of boron to "Conference" pear trees before full bloom increased fruit set and fruit yield [27]. Also, on Blueberry spray with all the three treatments (B, Ca, B+ Ca) increased the average germination of pollen grain [28]. Likewise, Wojcik and Treder [29] recommended that drip boron fertigation of "Jonagold" apple trees from bud burst stage to fruit set stage at a rate of 0.5 g/tree increased fruit set percentage and yield. Also, amino acid play important specific roles in number of cellular processes such as replication and translation of embryonic development, cell cycle programmed cell death and cancer [14].

Table 2. Effect of different sources of calcium treatments on fruit set (%) and fruit drop (%)of 'Canino' apricot trees under two types of soil during 2012/2013 seasons

Parameters		**Fruit set %**						**Fruit drop %**					
Treatments	**Conc.**	**sand**	**Clay**	**Mean A x B**	**sand**	**Clay**	**Mean A x B**	**Sand**	**clay**	**Mean A x B**	**sand**	**clay**	**Mean A x B**
	Cm^3/ L		**1st season**		**2nd season**			**1st season**			**2nd season**		
Inca	1	19.01e	0.96fg	1.11BC	1.30bc	1.26cd	1.28C	12.15g	17.79d	14.97E	25.77f	18.25i	22.01E
	2	27.83a	0.92g	1.07CD	1.60a	1.28cd	1.44AB	5.04h	12.25g	8.65F	30.56c	12.94j	21.75E
Calbor	2	4.86h	1.04e	1.21A	1.57a	1.37b	1.47A	12.29g	17.87f	15.08E	31.29c	27.57de	29.43B
	3	10.49g	0.93g	1.12B	1.60a	1.20d	1.40B	31.18a	16.18ef	23.68A	28.69d	27.47de	28.08C
Calciven	1	18.73e	0.85h	1.04D	1.37b	1.22cd	1.29C	21.63bc	15.17f	18.40D	20.53h	19.16i	19.84F
	2	20.33d	1.04e	1.18A	1.53a	1.37b	1.45AB	22.82b	16.88de	19.85C	22.83g	26.30ef	24.57D
Control	Tap water	16.67f	1.01ef	1.12B	1.23cd	1.00e	1.12D	21.77bc	21.31c	21.54B	25.90a	33.50b	34.70A
Mean C		16.83B	0.97B	Mean A	1.43A	1.21B	Mean A	18.58A	17.34B	Mean A	28.93A	24.84B	Mean A
Mean A x C		23.42B	0.94E	1.09C	1.45B	1.27CD	1.36B	8.60E	15.02D	11.81C	28.16D	15.59G	21.88C
		7.68F	0.99D	1.16A	1.58A	1.29CD	1.44A	21.74A	17.03B	19.38B	29.99C	27.52D	28.76B
		19.53D	0.94E	1.11BC	1.45B	1.29CD	1.37B	22.23A	16.02C	19.13B	21.68F	22.73E	22.20C
		16.67E	1.01D	1.12B	1.23D	1.00E	1.12C	21.77A	21.31A	21.54A	35.90A	33.50B	34.70A
Mean B x C		14.82D	0.97B	Mean B	1.37B	1.21C	Mean B	16.96C	18.03B	Mean B	28.37B	24.62C	Mean B
				1.12A			1.29B			17.50B			26.50B
		18.83C	0.97B	1.12A	1.49A	1.21C	1.35A	20.20A	16.66C	18.43A	29.49A	25.05C	27.27A

Means separated within column using LSD test at P≤0.05; Means followed by the same letter were not significantly different'

1-2 Fruit drop (%):

It was clear from data in Table (2) that spraying with Inca, significantly reduced the fruit drop percentage in both seasons under study, it reduced significantly the force required for removing apricot fruits at the two concentrations. The least retained fruits was obtained with control in the two seasons under study respectively, while Calbor treatment was intermediate in their effect. With respect the effect of soil type, it was obvious that fruit drop under clay soil conditions recorded the lowest fruits drop, whereas sand soil conditions recorded the highest fruit drop. However, in the 1st season, Inca spray at 2 cm^3/L on both soil types induced the lowest apricot fruit drop while in the 2nd season, Inca spray at 2 cm^3/L on clay soil showed the lowest fruit drop percentage (12.94%).

In this respect, Mendez et al. [30] mentioned that Ca cl_2 plays a role in increasing thickness of the cell wall and cuticle layers, so it protects the plant from fungal infection. Also, Talaie and Taheri [31] reported that B and Zn foliar sprays significant increased retained fruits of olives.

Abd El Moneim [32] similarly, showed that Calcium chloride is responsible for formation of strong cell walls of cotton.

1-3 yield (kg/tree)

It was obvious from data in Table (3) that apricot yield per tree (kg) as affected by spraying with Inca, Calbor and Calciven treatments increased significantly the fruit yield than control. Also, Inca and Calbor spray significantly induced the highest yield in the 1st season, while in 2nd season Calciven spray was the superior with both concentrations. Moreover, the yield goes in the same trend with fruit set percentage. It was found that spraying with Inca and Calbor either at high or low concentrations on sand soil had positive effect on fruit yield /tree followed in descending order by spraying with Calciven 1&2 cm^3/L.

Whereas, the lowest values were obtained from control on both types of soil in both season. In the second season data was conversed where Calciven at 1&2 cm^3/L recorded the highest values of yield per tree, it due to the change in weather during the spring (such as, temperature & winds). With respect of types of soil and the concentration of treatments, data showed that high concentration of treatments on the clay soil reduced the yield in the first season.

These results are in a line with, Galavi et al. [33] investigated the effect of zinc on growth and yield of many plants and observed an increase in yield with zinc application. Raese and Drake [34] was found that pear Cv."Anjou" increased in yield as response to sprays of $CaCl_2$. Long term sprays of $CaCl_2$ at 60 g/100L were recommended for increasing the yield of "Anjou" pear. Also, boron play a role in the nutrient interactions within plant [35] while amino acid take part in number of cellular process as replication and translation of embryonic development [14].

1-4 Monetary value:-

The present treatments supported apricot grower to get higher income especially with Inca and Calbor at the high concentration (69.33 & 69.5 LE) when compared with control (LE28.0) in the 1st season, but in the 2nd season Calciven at high concentration recorded the highest income (72.08 LE). However, higher concentration induced higher income especially on sand soil.

3-Leaf chemical content:-

3-1 Chlorophyll content

Data in Fig. 1 indicated that foliar application with different sources of calcium in both concentrations increased chlorophyll content significantly. It was noticed that there was a positive relation between the concentration of sources of calcium and chlorophyll content. Data clearly indicated that spraying trees with Calbor at 3 cm^3/1L water increased chlorophyll in leaves and delayed the development of yellow colour in the two seasons. Whereas, the lowest values were obtained from control in both seasons. Regarding the effect of type of soil, sand soil recorded the highest values but the differences were not significant in 2nd season.

3-2 Nitrogen content

Data in Table 4 indicate that spraying with Inca, Calbor and Calciven had a positive effect on leaf content of N than control in both seasons. It was found that spraying with Calbor, Calciven and Inca at high concentration recorded higher values of leaf content of N followed in a descending order by spraying with low concentration with all treatments during the two seasons. With respect to the type of soil no significant different between sand and clay in leaf content of N. Moreover, all studied compounds with both concentrations and on both soil types induced higher N leaf content than control. However, higher concentration increased N leaf content especially on clay soil.

These results seemed to be in agreement with Kabeel et al. [36] who indicated that foliar boron application to Le-Conte pear trees at full bloom increased leaf content of most macro-elements (including N, P, K and Ca) and micro-elements such as boron. Also, Abd El-Megeed and Wally [5] regarding a significant increased leaf N content on pear trees treated with chelated calcium and boron. Zlatimiza and Snejana [37] on Pea plants were treated with various Zn concentrations (0.67 to 700 MM Zn). Increase in Zn decrease the concentrations of Ca, Mg, P in roots and increase of Ca and N levels in the stems and leaves.

3-3 Calcium content

Data presented in Table4. Point out that spraying with Inca, Calbor and Calciven had positive effect of leaf content of Ca than control in both seasons. Spraying Calciven with two concentrations recorded the highest values of leaf content of Ca followed by Calbor at high concentration, whereas, the lowest values were recorded to untreated trees in both seasons. It was evident that clay soil conditions recorded the highest values of Ca in leaf. Also, apricot leaves gained much more Ca on clay soil than on sand soil with all present compounds, while higher concentrations induced higher leaf Ca content on sand soil through the two seasons of study. So, the highest Ca leaf content was noticed with Calciven 1 cm^3/L spray on clay soil (1.86 and 1.95%) in 2012 and 2013 seasons respectively.

These results are in line with those obtained by Wojcik and Wojcik [27] who found that foliar calcium application increased Ca concentration in "Jonagold" apple fruits. Calcium sprays increased Ca^{++} content and decreased K^+ content in the fruit than the control, and enhanced fruit quality of "Anna" apple fruits [38].

3-4 Boron content

Data shows that foliar spray with Inca, Calbor and Calciven had a positive effect on leaf content of B than untreated trees in both seasons (Table 5). Spraying Calciven at 1 cm^3/1 L water (low concentration) recorded the highest values of B followed in descending order by spraying with Inca at low concentration in both seasons. With respect to effect of the type of soil, it was clear that the highest values were recorded to clay soil.

These results were in line with Wooldridge [39] who found that boron sprays on apricot and peach showed an increase of leaf and fruit B levels. Carpena - Artes and Carpena- Ruiz [40] reported that the deficient states of B decreased the leaf N, P, Ca, Mg, Fe, Cu, Zn and B in tomato. On the other hand, excess B increased the concentration of nutrients with greater significance of K, Mg and Fe followed by Ca and Mn and smaller quantity cu and Zn.

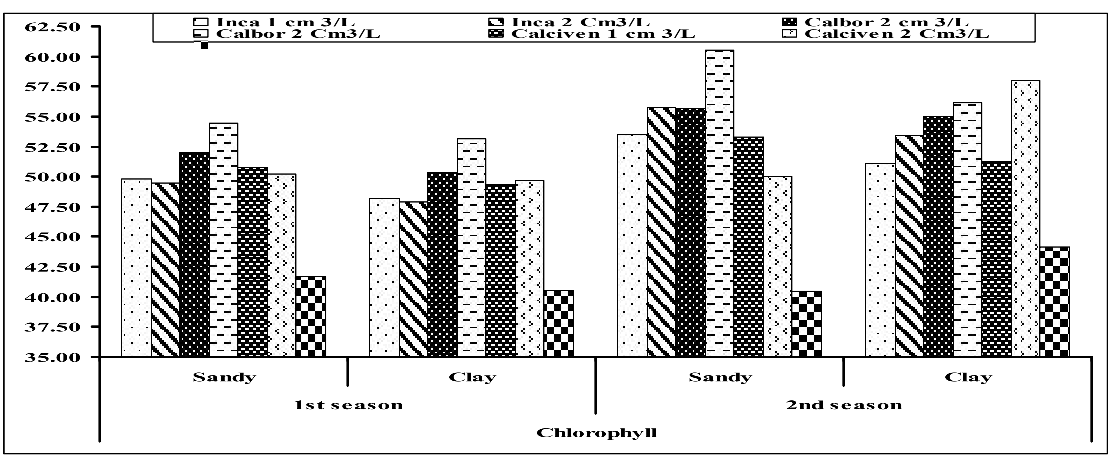

Fig. 1. Effect of different sources of calcium on chlorophyll reading of ' Canino ' apricot leaves during 2012/2013 seasons

Table 3. Effect of different sources of calcium treatments on yield (Kg/tree) and Monetary value (LE) of "Canino" apricot trees under two types of soil during 2012/2013 seasons

Parameters		Yield (kg/tree)						Monetary value (LE/kg)					
Treatments	Conc. Cm^3/ L	Sand	Clay	Mean A x B	Sand	Clay	Mean A x B	Sand	Clay	Mean AX B	Sand	Clay	Mean A x B
		1st season			2nd season			1st season			2nd season		
Inca	1	47.33b	44.00cd	45.67A	35.00d	35.00d	35.00E	54.00f	44.00g	49.00D	52.50d	35.00h	43.7E
	2	49.33ab	40.00ef	44.67A	38.33c	41.67b	40.00B	98.66b	40.00h	69.33A	76.66a	41.67f	59.17D
Calbor	2	46.67bc	42.67de	44.67A	38.00c	38.33c	38.17C	93.34c	42.67g	68.01B	76.00a	52.50c	66.75B
	3	50.67a	37.67f	44.17A	38.33c	35.00d	36.67D	101.34a	37.67i	69.50A	76.66a	52.50d	64.58C
Calciven	1	38.33f	38.33f	37.67C	36.67cd	44.17a	40.42AB	57.50e	38.33i	47.92E	36.67g	44.17e	40.42F
	2	46.67bc	37.33f	42.00B	38.33c	45.00a	41.67A	70.01d	37.33i	53.67C	76.66a	67.50b	72.08A
Control	Tap water	28.33g	27.67g	28.00D	25.00f	30.00e	27.50F	28.33j	27.67j	28.00F	25.00j	30.00i	27.50G
Mean C		41.96A	37.00B	Mean A	34.33B	37.40A	Mean A	66.44A	36.92B	Mean A	55.61A	44.79B	Mean A
Mean A x C		48.33A	42.00B	45.17A	36.67C	38.33B	37.50B	76.33B	42.00D	59.17B	64.58B	38.33F	51.46C
		48.67A	40.17C	44.42A	38.17BC	36.67C	37.42B	97.35A	40.17E	68.76A	76.33A	55.00E	65.67A
		42.50B	38.17D	40.33B	37.50BC	44.58A	41.04A	63.76C	37.83F	50.79C	56.67C	55.83D	56.25B
		28.33E	27.67E	28.00C	25.00E	30.0D	27.50C	28.33G	27.67G	28.00D	25.00H	30.00G	27.50D
Mean B x C		40.17B	38.33C	Mean B 39.25A	33.67D	36.88B	Mean B 35.27B	58.29B	38.17C	Mean B 48.23B	47.54B	41.67C	Mean B 44.60B
		43.75A	35.67D	39.71A	35.00C	37.92A	36.46A	74.58A	35.67D	53.13A	63.75A	47.92B	55.83A

Means separated within column using LSD test at P≤0.05; Means followed by the same letter were not significantly different'

Table 4. Effect of different sources of calcium on content of N and Ca ' Canino' apricot leaves during 2012/2013 seasons

Parameters		N %			Ca %		
Treatments	Conc. (Cm^3/L)	Sand	Clay	Mean A x B	Sand	Clay	Mean A x B
				1^{st} season			
Inca	1	2.65gh	2.60hi	2.63D	1.05e	1.64c	1.35C
	2	2.88ab	2.70e-g	2.79A-C	1.11e	1.67c	1.39C
Calbor	2	2.90a	2.75d-f	2.83A	1.25d	1.68bc	1.47B
	3	2.68fg	2.84a-c	2.76BC	1.35d	1.71bc	1.53A
Calciven	1	2.77c-e	2.71e-g	2.74C	1.27d	1.86a	1.57A
	2	2.80cd	2.81b-d	2.81AB	1.31d	1.77b	1.54A
Control	Tap water	2.50j	2.55ij	2.53E	1.10e	1.30d	1.20D
Mean C		2.71A	2.69A	Mean A	1.19B	1.62A	Mean A
Mean A x C		2.77A	2.65B	2.71B	1.08D	1.66B	1.37C
		2.79A	2.80A	2.79A	1.30C	1.70B	1.50B
		2.79A	2.76A	2.77A	1.29C	1.82A	1.55A
		2.50C	2.55C	2.53C	1.10D	1.30C	1.20D
Mean B x C		2.71A	2.65B	Mean B	1.17C	1.62A	Mean B
				2.68B			1.39A
		2.72A	2.73A	2.72A	1.22B	1.61A	1.42A
				2^{nd} season			
Inca	1	2.85ef	2.75fg	2.80C	1.10f	1.72c	1.41C
	2	3.00b-d	2.90de	2.95B	1.17f	1.75c	1.46C
Calbor	2	3.15a	3.00b-d	3.08A	1.31e	1.76c	1.54B
	3	2.85ef	3.05a-c	2.95B	1.42d	1.80bc	1.61A
Calciven	1	2.95c-e	2.91de	2.93B	1.33de	1.95a	1.64A
	2	3.10ab	3.01b-d	3.06A	1.38de	1.86b	1.62A
Control	Tap water	2.60h	2.65gh	2.63D	1.16f	1.37de	1.26D
Mean C		2.89A	2.87A	Mean A	1.25B	1.70A	Mean A
Mean A x C		2.93B	2.83C	2.88B	1.13D	1.74B	1.44C
		3.00AB	3.03A	3.01A	1.37C	1.78B	1.57B
		3.03A	2.96AB	2.99A	1.35C	1.91A	1.63A
		2.60D	2.65D	2.63C	1.16D	1.37C	1.26D
Mean B x C		2.89A	2.83B	Mean B	1.23C	1.70A	Mean B
				2.86A			1.46A
		2.89A	2.90A	2.90A	1.28B	1.69A	1.49A

Means separated within column using LSD test at $P \le 0.05$; Means followed by the same letter were not significantly different'

3-5 Zinc content

As shown in Table (5) it is evident that spraying with Inca, Calbor and Calciven had a positive effect on leaf content of Zn compared with untreated trees in both seasons under study.

Spraying Calbor either at 2 cm^3/1L or 3 cm^3/1L water recorded the highest values of leaf content of Zn followed in descending order by spraying of Inca at high concentration and Calciven at both low and high concentrations. About the treatments concentration, it is evident that the high concentration had higher effect than low concentration in all treatments during the two seasons under study.

With respect of types of soil obviously values of leaf content of Zn under clay soil conditions recorded the highest zinc values in both seasons. We can observed the increase of zinc with Calbor and Calciven treatments at high and low concentrations which may be due to some interaction indirectly where Alvarez -Tinaut [41] found a positive correlation between Zn & b, also, indicate that B could indirectly affect some enzyme through modification of Zn content.

2- Fruit physical properties:-

2-1 Fruit weight (gm)

Data in Table (6) revealed that spraying with Inca, Calciven and Calbor affected positively on "Canino" fruits in both seasons under study than control. With respect to types of soil, it was clearly that values of fruit weight under sand soil condition recorded the highest values and higher concentration of treatments had higher significant fruit weight.

Spraying Calbor either at 2 or 3 cm^3/L water, Calciven at 1&2 cm^3/L and Inca 1&2 cm^3/L water recorded the highest values of fruit weight in both seasons. So, "Canino" apricot fruits were heavier with higher concentration on sand soil. Also, the present treatments significantly increased the fruit weight than control on sand soil.

Our results go in line with , Abd El- Megeed and Wally [5] who found that highest yield and fruit weight of "Le-Conte "pear trees were recorded with the combination of boric acid at 0.2% & chelated calcium at 0.3% treatments as compared to the control.

2-2 Fruit volume

As shown in Table 6, data showed that spraying with Calbor 3 cm^3/1 L water under sand soil conditions recorded the highest fruit size, followed in a descending order by Calbor in low concentration. Whereas, the lowest values were obtained from control in both seasons. Higher concentration of treatments and the sand soil significantly gave the highest fruit size.

Table 5. Effect of different sources of calcium on Zn and B content of "canino" apricot leaves during 2012/2013 seasons

Parameters		Zn (ppm)			B (ppm)		
Treatments	Conc.(Cm^3/L)	Sand	clay	Mean A x B	Sand	clay	Mean A x B
				1st season			
Inca	1	42.11g	50.91b-d	46.51D	31.61d	41.32b	36.47C
	2	46.58f	52.11b	49.35C	29.15f	42.00b	35.58D
Calbor	2	51.11b-d	51.08b-d	51.10B	32.36d	39.15c	35.76CD
	3	54.56a	50.11d	52.33A	31.16de	38.77c	34.94D
Calciven	1	48.19e	50.34cd	49.26C	41.00b	46.71a	43.85A
	2	47.33ef	51.56bc	49.44C	38.16c	41.09b	39.63B
Control	Tap water	40.23h	41.42g	40.82E	25.01g	30.15ef	27.58E
Mean C		46.29B	48.62A	Mean A	31.68B	38.67A	Mean A
Mean A x C		44.35E	51.51B	47.93C	30.38E	41.66B	36.02B
		52.83A	50.60C	51.72A	31.76D	38.96C	35.36C
		47.76D	50.95BC	49.35B	39.58C	43.90A	41.74A
		40.23G	41.42F	40.82D	25.01F	30.15E	27.58D
Mean B x C		45.41C	48.44A	Mean B	32.49C	39.33A	Mean B
				46.92B			35.91A
		47.18B	48.80A	47.99A	30.87D	38.00B	34.44B
				2nd season			
Inca	1	43.58g	52.69b-d	48.14D	33.03de	43.18b	38.11C
	2	48.21f	53.93b	51.07C	30.46g	43.89b	37.18D
Calbor	2	52.90b-d	52.87b-d	52.88B	33.82d	40.91c	37.37CD
	3	56.47a	51.86d	54.16A	32.56ef	40.51c	36.53D
Calciven	1	49.88e	52.10cd	50.99C	42.85b	48.81a	45.83A
	2	48.99ef	53.36bc	51.17C	39.88c	42.94b	41.41B
Control	Tap water	41.64h	42.87g	52.25E	26.14h	31.51fg	28.82E
Mean C		47.91B	50.32A	Mean A	33.11B	40.41A	Mean A
Mean A x C		45.90E	53.31B	49.60C	31.75E	43.54B	37.64B
		54.68A	52.36C	53.52A	33.19D	40.71C	36.95C
		49.43D	52.73BC	51.08B	41.36C	45.88A	43.62A
		41.64G	42.87F	52.25D	26.14F	31.51E	28.82D
Mean B x C		47.00C	50.13A	Mean B	33.96C	41.10A	Mean B
				48.57B			37.53A
		48.43B	50.51A	49.67A	32.26D	39.71B	35.99B

Means separated within column using LSD test at P≤0.05; Means followed by the same letter were not significantly different'

2-3 Fruit dimensions

It's noticed that the dimensions of apricot fruits go in same trend with the weight where there is a positive significant increase of treatments in both seasons under study parallel to the increment in fruit weight (Table 7). Data revealed that spraying with Calbor, Inca and Calciven had a positive effect on fruit dimensions compared with control in both seasons under study. It was found that spraying with Calbor at 3 cm/1 L water recorded the highest value of fruit diameter in the first season.

Inca, Calbor and Calciven at high concentrations significantly recorded the highest values of fruit diameter in the second season. With respect to effect of types of soil, it was clear that fruit dimensions under sand soil conditions recorded the highest values. Whereas; the lowest values were obtained under clay soil conditions in both seasons.

Table 6. Effect of different sources of calcium on fruit weight (g) and fruit volume (ml) of 'Canino" apricot trees under two types of soil in 2012/2013 seasons

Parameters		Fruit weight (g)			Fruit volume (ml)		
Treatments	**Conc. Cm^3/L**	**sand**	**Clay**	**Mean A x B**	**sand**	**Clay**	**Mean A x B**
				1st season			
Inca	1	45.40c	34.65f-h	40.02B	42.40c	32.87g	37.63D
	2	48.77ab	36.47de	42.62A	46.43ab	35.83e	41.13B
Calbor	2	48.19b	36.31d-f	42.25A	46.67ab	35.17ef	40.92B
	3	50.75a	35.77d-g	43.26A	47.75a	39.00d	43.37A
Calciven	1	48.10b	33.02h	40.56B	44.83b	33.50fg	39.17C
	2	47.90b	37.53d	42.72A	45.00b	34.00e-g	39.50C
Control	Tap water	34.05f-h	33.63gh	33.84C	37.85d	30.33h	34.09E
Mean C		44.65A	35.13B	Mean A	43.60A	33.88B	Mean A
Mean A x C		47.08B	35.56CD	41.32B	44.42B	34.35D	39.38B
		49.47A	36.04C	42.75A	47.21A	37.08C	42.15A
		48.00AB	35.28CD	41.64B	44.92B	33.75D	39.33B
		34.05DE	33.63E	33.84C	37.85C	30.33E	34.09C
Mean B x C		43.93B	34.40D	Mean B 39.17B	42.94B	32.97D	Mean B 37.95B
		45.37A	35.85C	40.61A	44.26A	34.79C	39.52A
				2nd season			
Inca	1	38.92ef	38.08fg	38.50C	40.33ef	38.46f	39.40D
	2	47.66b	38.08fg	42.87A	47.17b	39.55ef	43.36C
Calbor	2	41.98d	39.95d-f	40.97B	46.67b	43.57cd	45.12B
	3	49.82a	36.13g	42.98A	51.67a	44.00c	47.83A
Calciven	1	45.42c	40.35de	42.88A	30.33h	33.67g	32.00E
	2	44.40c	40.87de	42.64A	47.00b	41.50de	44.25BC
Control	Tap water	34.04h	31.63i	32.83D	34.00g	31.33h	32.67E
Mean C		42.04A	37.09B	Mean A	41.40A	37.93B	Mean A
Mean A x C		43.29B	38.08D	40.69B	43.75B	39.00C	41.38B
		45.90A	38.04D	41.97A	49.17A	43.78B	46.47A
		44.91A	40.61C	42.76A	38.67C	37.58C	38.13C
		34.04E	31.63F	32.83C	34.00D	31.33E	32.67D
Mean B x C		40.09B	37.50C	Mean B 38.80B	37.83C	36.76D	Mean B 37.29B
		43.98A	36.68C	40.33A	44.96A	39.10B	42.03A

Means separated within column using LSD test at P≤0.05; Means followed by the same letter were not significantly different'

In relation to fruit length, it was found that spraying Inca with high concentration 2 cm^3/1 L water significantly increased fruit length, in the first season while in the second season spraying Calciven at 2 cm^3/1 L water and Inca at the same concentration gave the highest value of fruit length, Data obtained that sand soil conditions recorded the highest fruit length whereas, the lowest values were recorded under clay conditions in both seasons It was evident that the highest concentration of all treatments gave significant increased in fruit length in both seasons.

Ismail [42] on "Desert red" peach fruit found that $CaCl_2$ did not cause significant change in fruit dimensions.

2-4 Fruit flesh thickness

Data in Table (8) revealed that spray with Calbor at 2 cm^3/L gave the highest values of flesh thickness followed by Calciven at 2 cm^3/1 L water (high concentration) in both seasons, whereas, the lowest values were obtained from control. It was clear that values of flesh thickness under sand soil conditions recorded significant higher values whereas clay soil conditions were the least in both seasons. However, all the studied treatments significantly increased flesh thickness than control specially Calbor (1.16 and 1.44 cm), which gave better results on sand soil.

Table 7. Effect of different sources of calcium on fruit dimension (cm) of "Canino" apricot trees under two types of soil in 2012/2013 seasons

Parameters		**Diameter (cm)**			**Length(cm)**		
Treatments	**Conc. cm^3/L**	**Sand**	**Clay**	**Mean A x B**	**Sand**	**Clay**	**Mean A x B**
				1^{st} season			
Inca	1	45.09b	40.23d	42.66B	46.10b	40.03e	43.06B
	2	45.16b	40.00d	42.58B	50.37a	39.50e	44.94A
Calbor	2	44.96b	40.17d	42.56B	46.34b	37.67f	42.01C
	3	46.25a	40.45d	43.35A	46.91b	40.25e	43.58B
Calciven	1	42.37c	40.32d	41.34C	44.77c	40.15e	42.46C
	2	40.50d	40.22d	40.36D	46.87b	40.19e	43.53B
Control	Tap water	40.34d	38.48e	39.41E	41.78d	36.33g	39.06D
Mean C		43.13A	39.79B	Mean A	45.62A	38.81B	Mean A
Mean A x C		45.13B	40.11D	42.62B	48.24A	39.76E	44.00A
		45.60A	40.31D	42.96A	46.63B	38.96F	42.79B
		41.43C	40.27D	40.85C	45.82C	40.17E	42.99B
		40.34D	38.48E	39.41D	41.78D	36.33G	39.06C
Mean B x C		43.19A	39.80B	Mean B	44.75B	38.54D	Mean B
				41.49A			41.65B
		43.06A	39.79B	41.42A	46.48A	39.07C	42.78A
				2^{nd} season			
Inca	1	40.49a-c	38.61f	39.55BC	39.65a	34.93d	37.29C
	2	40.48a-c	40.09b-d	40.28A	40.35a	39.96a	40.16A
Calbor	2	39.55de	38.63f	39.09C	37.14bc	37.22bc	37.18C
	3	40.65ab	39.33e	39.99AB	40.47a	37.62b	39.05B
Calciven	1	41.07a	37.91f	39.49BC	40.49a	36.62c	38.56B
	2	40.42a-c	39.80c-e	40.11A	40.44a	39.67a	40.06A
Control	Tap water	34.75g	34.91g	34.83D	33.21e	35.47d	34.34D
Mean C		39.02A	38.02B	Mean A	38.12A	37.12B	Mean A
Mean A x C		40.49AB	39.35C	39.92A	40.00A	37.44D	38.72B
		40.10B	38.98C	39.54B	38.81B	37.42D	38.12C
		40.75A	38.86C	39.80AB	40.47A	38.15C	39.31A
		34.75D	34.91D	34.83C	33.21F	35.47E	34.34D
Mean B x C		39.96A	37.51C	Mean B	37.62C	36.06D	Mean B
				38.24B			36.84B
		39.08A	38.53B	38.80A	38.62A	38.18B	38.40A

Means separated within column using LSD test at P≤0.05; Means followed by the same letter were not significantly different'

Table 8. Effect of different sources of calcium on flesh thickness (cm) and fruit firmness (lb/inch^2) of 'Canino apricot trees under two types of soil in 2012/2013 seasons

Parameters		Flesh thickness			Firmness(lb/inch^2)		
Treatments	**Conc. cm^3/L**	**Sand**	**Clay**	**Mean A x B**	**Sand**	**Clay**	**Mean A x B**
				1st season			
Inca	1	1.26c	0.96fg	1.11BC	5.68d	5.30ef	5.49B
	2	1.23d	0.92g	1.07CD	6.32b	5.20f	5.76A
Calbor	2	1.37a	1.04e	1.21A	6.04c	4.40hi	5.22C
	3	1.31b	0.93g	1.12B	5.65d	4.33i	4.99D
Calciven	1	1.23d	0.85h	1.04D	5.47e	4.53h	5.00D
	2	1.32b	1.04e	1.18A	7.00a	4.30i	5.65A
Control	Tap water	1.22d	1.01ef	1.12B	5.13fg	4.97g	5.05D
Mean C		1.27A	0.97B	Mean A	5.80A	4.75B	Mean A
Mean A x C		1.24B	0.94E	1.09C	6.00B	5.25D	5.62A
		1.34A	0.99D	1.16A	5.85C	4.37F	6.11C
		1.28B	0.94E	1.11BC	6.23A	4.42F	5.33B
		1.22C	1.01D	1.12B	5.13D	4.97E	5.05C
Mean B x C		1.27A	0.97B	Mean B	5.58B	4.80C	Mean B
				1.12A			5.19B
		1.27A	0.97B	1.12A	6.02A	4.70D	5.36A
				2nd season			
Inca	1	1.30b	1.26cd	1.28C	6.60e	7.80b	7.20B
	2	1.60a	1.28cd	1.44AB	6.07f	6.90d	6.48D
Calbor	2	1.57a	1.37b	1.47A	6.57e	6.67de	6.62CD
	3	1.60a	1.20d	1.40B	7.43c	6.17f	6.80C
Calciven	1	1.37b	1.22cd	1.29C	6.67de	5.80g	6.23E
	2	1.53a	1.37b	1.45AB	9.43a	5.53h	7.48A
Control	Tap water	1.23c	1.00e	1.12D	4.80i	4.90i	4.85F
Mean C		1.43A	1.21B	Mean A	6.55A	6.08B	Mean A
Mean A x C		1.45B	1.27C	1.36B	6.33D	7.35B	6.84A
		1.58A	1.29C	1.44A	7.00C	6.42D	6.71B
		1.45B	1.29C	1.37B	8.05A	5.67E	6.66A
		1.23D	1.00E	1.12C	4.80F	4.80F	4.85C
Mean B x C		1.37B	1.21C	Mean B	6.16C	6.29B	Mean B
				1.29B			6.23B
		1.49A	1.21C	1.35A	6.93A	5.88D	3.40A

Means separated within column using LSD test at P≤0.05; Means followed by the same letter were not significantly different'

2-5 Fruit firmness(lb/inch^2)

Data in Table (8) show that spraying different sources of calcium had a positive effecte on firmness of fruit in both seasons compared with the control. However,it was found that applying Calciven at 2 cm^3 conc./1 L water gave the highest fruit firmness in the two seasons especially on sand soil, but Inca at 2 cm^3/1L water was higher in the first season only. It was obvious that sand soil conditions recorded the highest fruit firmness compared with clay soil in both seasons. Also, higher concentration was better especially on sand soil.

These results are in line with those obtained by Mir et al. [43] on" Red Delicious" and "Geraspoulos" and by Richardson [44] on

"Anhou" pear who found that calcium sprays during fruit development of fruits increased fruit weight and flesh firmness. Also, Basham and Bateman [45] reported that mechanism of pectinase enzyme on the plant cell walls is decreased the cell injury supports the view of the cell wall breakdown is responsible for the death.

3-Fruit Chemical Properties:-

Data concerning the values of T.S.S and total acidity as affected by different sources of calcium treatments as shown in Table (9).

3-1Total soluble solids %

Total soluble solids percentage of "Canino "apricot fruits were significantly increaseed by all different calcium sources treatments, concentrations and types of soil in both seasons of study (Table 9). Data shows that all treatments had significant effect on TSS of fruit juice compared with the control in both seasons. Spraying Inca at 2 cm^3/1 L water and Calciven treatment at 2 cm^3/1 L water recorded the highest values of TSS followed Calbor at 3 cm^3/1 L water, while the control exhibited the lowest values in both seasons, respectively.

Concerning the effect of soil types, the highest values of TSS were recorded by sand soil in the first season, whereas, in the second season the highest values were produced by clay soil. In addition, Abd El-Megeed and wally [5] concluded that chelated calcium alone or combined with boric acid increased TSS of "Le-Conte" pear trees.

3-2 Acidity

It is cleared that there are significant differences found between the different calcium sources in total acidity compared with control.

As shown in Table (9), It is noticed that spraying Calciven with high concentration (2 cm^3/1 L water) recorded the highest values of acidity % followed by Calbor at high concentration (3 cm^3/1 L water), the least values recorded by control and Inca treatment in the first season. Moreover in the second season the differences between all treatments were not significant.

With regard to the effect of soil type, it was clear that sand soil record the highest values of acidity % during the two seasons, whereas clay soil condition were the least.

On "Anna" apple trees, boric acid caused insignificant effect on fruit diameter, length, volume and weight but sprays increased acidity, total sugars and anthocyanin content [46].

3-3 TSS/acid ratio:-

It conducted to indicate the degree of good taste. The present data showed Inca compound induced higher ratio in the 1st season while Calciven get higher in 2nd season. However, TSS/acid ratio was higher on clay soil. Also, low concentration had higher ratio but some differences did not reach the significance. The interactions cleared that low concentrations of the studied compounds caused higher ratio especially on clay soil.

Table 9. Effect of different sources of calcium on chemicals properties of 'Canino apricot trees under two types of soil in 2012/2013 seasons

Parameters		TSS %			Acidity %			TSS/Acidity ratio		
Treatments	**Conc. cm^3**	**Sand**	**clay**	**Mean A x B**	**Sand**	**clay**	**Mean A x B**	**Sand**	**clay**	**Mean A x B**
					1st season					
Inca	1	15.10b	14.41e	14.76D	2.30gh	2.23h	2.67D	6.57a	6.46a	6.51A
	2	15.67a	14.85c	15.26A	2.57d-f	2.42f-h	2.50C	6.10bc	6.14bc	6.14B
Calbor	2	15.13b	14.67cd	14.90C	2.33gh	2.27gh	2.30D	6.49a	6.46a	6.50A
	3	15.23b	14.85c	15.04BC	2.79bc	2.68b-d	2.73B	5.46d	5.54d	5.50C
Calciven	1	15.20b	14.82c	15.01C	2.80bc	2.63c-e	2.72B	5.43de	5.63d	5.53C
	2	15.57a	14.75cd	15.16AB	3.00a	2.87ab	2.93A	5.19e	5.14e	5.16D
Control	Tap water	14.60de	14.57de	14.58E	2.46e-g	2.28ghb	2.37CD	5.93c	6.39ab	6.16B
Mean C		15.14A	14.68B	Mean A	2.59A	2.46B	Mean A	5.89A	6.02A	Mean A
Mean A x C		15.38A	14.63DE	15.01AB	2.43CD	2.33DE	2.38C	6.33A	6.30A	6.34A

Parameters		TSS %			Acidity %			TSS/Acidity ratio		
Treatments	Conc. cm^3	Sand	clay	Mean A x B	Sand	clay	Mean A x B	Sand	clay	Mean A x B
					1st season					
		15.18B	14.76CD	14.97B	2.56C	2.47C	2.52B	5.98B	6.00B	5.99B
		15.38A	14.78C	15.08A	2.90A	2.75B	2.83A	5.31C	5.39C	5.36C
		14.60E	14.57E	15.58C	2.46CD	2.28E	2.37C	5.93B	6.39A	6.19AB
Mean B x C		15.01B	14.61D	Mean B 14.81B	2.47C	2.35D	Mean B 2.41B	6.11A	6.24A	Mean B 6.19A
		15.27A	14.75C	15.01A	2.70A	2.56B	2.63A	5.67B	5.80B	5.78B
					2nd season					
Inca	1	14.67b	14.97a	14.82A	2.82a	2.60c-e	2.71A	5.20gh	5.76a-c	5.48C
	2	14.67b	14.93ab	14.80A	2.77ab	2.65b-e	2.71A	5.30fg	5.63cd	5.46C
Calbor	2	14.00c	14.87ab	14.43B	2.57de	2.55de	2.56B	5.45d-f	5.83ab	5.64AB
	3	14.67b	14.93ab	14.80A	2.75a-c	2.60c-e	2.68A	5.33e-g	5.74a-c	5.54BC
Calciven	1	14.67b	14.9ab	14.78A	2.67a-d	2.53de	2.60AB	5.50de	5.89ab	5.69A
	2	14.67b	14.80ab	14.73A	2.57de	2.63b-e	2.60AB	5.71bc	5.63cd	5.67AB
Control	Tap water	14.00c	14.80ab	14.40B	2.77ab	2.50e	2.63AB	5.05h	5.92a	5.49C
Mean C		14.42B	14.88A	Mean A	2.71A	2.57B	Mean A	5.32B	5.79A	Mean A
Mean A x C		14.67B	14.95A	14.81A	2.79A	2.63B	2.71A	5.25E	5.70BC	5.48C
		14.33C	14.90A	14.62B	2.66B	2.58BC	2.62B	5.39D	5.79B	5.59B
		14.67B	14.85A	14.76A	2.62B	2.58BC	2.60B	5.60C	5.76B	5.68A
		14.00D	14.80AB	14.40C	2.77A	2.50C	2.63B	5.05F	5.92A	5.49C
Mean B x C		14.33C	14.88A	Mean B 14.61A	2.70A	2.55B	Mean B 2.63A	5.30C	5.85A	Mean B 5.58A
		14.50B	14.87A	14.68A	2.71A	2.60B	2.65A	5.35C	5.73B	5.54A

Means separated within column using LSD test at P≤0.05; Means followed by the same letter were not significantly different

4. CONCLUSION

Calcium, zinc, boron and amino acid play an important role in fruit set, fruit retention and development and cause efficient yield and quality improvement. Our results revealed that spraying different sources of calcium such as Inca (Ca & Zn), Calbor (Ca & B) and Calciven (Ca & B and amino acids) improved fruit set, and leaf nutrient content while decreased fruit drop herein reflected on yield and fruit quality.

Higher concentration of the studied treatments was mostly more effective than low one. Moreover, clay soil supported better fruit set, yield, leaf chlorophyll (in the 2^{nd} season), Ca, Zn, and B fruit TSS (in the 2^{nd} season). On the other hand, sand soil encouraged fruit weight, size, dimensions, flesh thickness ad firmness but also increased fruit drop.

However, many investigators have reported beneficial effect of the present treatments. Mahrous and El-Fakhrani [47,5] showed that zinc foliar spray increased fruit set, yield and leaf mineral content. Pahlsson [48] cleared that, zinc plays an important role in several plant metabolic processes where it activates enzymes and involved in protein synthesis and carbohydrate, nucleic acid and lipid metabolism.

Boron 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 [49]. Also, it is a maturity in disc which indicate the degree of eating quality (for good taste fruit sugar to acid. B plays a role in the nutrient interactions within plant [35] and increased fruit quality [5]. In addition to, calcium applications had more pronounced effect on fruit set, yield and fruit quality of pear ad plum [50,51,52].

Meanwhile, amino acids enhanced fruit set, yield and fruit quality of apple, pear and plum [53,54,55, 15]. However, Gemici et al. [14] suggested that, cytokinin and auxin, a plant growth hormone and regulating cell cycle progression, could be correlated with polyamines. It can be concluded that spraying calcium in different source improved fruit set, fruit retention and development and cause efficient yield and quality under two types of soil (sandy or clay). Also, the highest concentration for all different sources of calcium (Ca & B chelated on hepta glouconic acid, Ca & Zn and soluble $CaCl_2$ chelated on amino and organic acids & 5% B) used improves fruit quality especially in sandy soil. Spraying different sources of calcium in clay soil recorded the best fruit set, yield, leaf chlorophyll, Ca, Zn, B and TSS while in sandy soil encouraged fruit weight, size, and dimensions flesh thickness and firmness.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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