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EFFECT OF CALCIUM AND BORON AS FOLIAR SPRAY ON "LE CONTE" PEAR TREES PRODUCTIVITY

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ABSTRACT: ***This study was carried out during 2016 and 2017 seasons on twenty years old "Le Conte" pear trees budded on Pyrus communis rootstock, grown at El-Kanater Horticultural Research Station to investigate the effect of foliar application of Ca (NO3)^2 (1 and 2 %) and borax (100 and 200 ppm) as individual or in combined on yield, leaf mineral content and fruit characteristics. The results obtained that, the highest fruit length, size, and diameter as well as fruit weight (g), fruit yield/ tree (kg) and fruit yield as ton/ fed. were recorded when pear tree was sprayed with 1or 2 % calcium nitrate + 100 or 200 ppm borax compared with both calcium and borax alone. Fruit firmness and acidity were increased by foliar spray of combined treatment calcium 100 or 200 ppm borax + 1 or 2 % Ca (NO$_3$)^2 compared to control. Spraying 1 or 2% Ca (NO3)^2 alone gave the highest significant value of N % for pear leaves meanwhile P % was improved significantly using 200 ppm borax + 2% Ca (NO$_3$)^2. Also, K, Ca and Mg % were increased significantly with spraying 200 ppm borax +2 % Ca (NO$_3$)^2. In most cases, leaf Fe and Zn contents were increased significantly by combined treatment of 100 or 200 ppm borax + 2 % Ca (NO$_3$)^2 or 100 ppm borax alone .***

Kew words: ***Pear trees, Le-conte, calcium, boron, yield and fruit quality***

INTRODUCTION

Pear (*Pyrus communis* L.) is one of the favorite fruits of temperate zone and considered the third highest production of deciduous fruits, the fourth highest production among all fruits in its global distribution and one of the most vital deciduous fruits in Egypt. 'Le Conte' pear resulted as a hybrid between *Pyrus communis* L. x *Pyrus serotina* L., is the main pear cultivar grown in Egypt. The total cultivated area for pear fruits were 3741 hectares with total production estimated to 48817 ton (FAO, 2016). Pear orchards productivity differs in Egypt from year to year and location to another. This might be attributed to limited ovules viability and stigma receptivity, deprived pollen germinability, ovule abortion, extreme flower abscission and low fruit set (Goldwin, 1986). Since consumers prefer large pears, fruit size becomes a very important marketing parameter and the economic benefits of treatments capable of improving average fruit size are considered of high potential.

Calcium is a nutritional element that differs from others by being imported into fleshy fruit only in small quantities, much less than into leaves. Ca uptake and distribution in plant is affected by internal water movement and relative Ca rate seems to be used along the transport pathway (Saure, 2005). Although it is sufficiently available in the soil, localized Ca deficiency may become a problem in several fruit crops, with the large economic losses risk. Some authors suggested a competition for Ca between low-transpiring fruit and vigorously growing, highly transpiring leafy shoots (Montanaro *et al.,* 2006). Calcium promotes early root formation

and growth, improves general plant vigor, stiffness of stalks and improves fruit integrity. Calcium influences the uptake of other nutrients such as phosphorous, manganese, iron, zinc and boron (Polevoiy, 1989). Calcium is considered one of the most important element for fruit crops in arid and semi-arid regions, since it is required for cell elongation and cell division (Rizzi and Abruzzese, 1990). The foliar application of "Kelsey" plum with Ca $(NO_3)^2$ greatly improved the fruit set, nitrogen and calcium leaf content, retained fruits, fruit weight and tree yield, over control (Abdel Hafeez *et al.,* 2010). Calcium plays a vital role in regulating the metabolism in apple fruit, maintaining adequate concentration for fruit firmness and delaying fruit ripening (Demuth and Sundrud, 2012). The beneficial effect of calcium in increasing fruit set may be due to the high efficiency of photosynthesis and these chemicals are also associated with hormone metabolism, which promotes synthesis of auxins, essential for fruit set and growth (Kazemi, 2014).

Boron (B) is considered an essential micronutrient that is associated with both vegetative growth and plant reproductive development, and it has been involved in the antioxidant systems of vascularized plants. It is also involved in changes in concentration and metabolism of phenolic compounds in vascular plants, in response to its excess or deficiency (Dahajipour *et al.,* 2011; Moalermi *et al.,* 2012). The B requirements have also been reported to be greater in reproductive than vegetative structures due to it is involved in several processes, such as flowering, pollen tube growth, and fruit ripening (Herrera- RodrIguez *et al.,* 2010). Foliar spraying of B to crops during the reproductive season, more effective than soil applications, this method has the advantages of requiring lower application rates, a more uniform distribution and more rapid plant responses to application of nutrients (Saadati *et al.,* 2013). foliar B applications are included in the agronomical management during the blueberry reproductive season to ensure a good fruit set and increased yield, and the applications are combined with other nutrients, such as calcium (Ca) (Stückrath *et al.,* 2008). Wimmer and Eichert, (2012) indicated that B facilitates the transport of sugars produced by the formation of B-sugar complexes or the increased leaf photosynthesis rate caused by the role of B on physiological processes. In addition to water, fruits are rich in sugars, two constituents for which B plays a key role in translocation. The role of B in the reduction of the oxidative stress that related to the increase in reactive oxygen species (ROS) which has been reported in the nuts of species such as European hazelnut (Mishra *et al.,* 2010). Therefore, the present investigation was carried out to investigate the effect of the most promising chemical treatments on improving fruit set, yield and fruit quality of Le Conte pear tree by using different concentrations of boron and calcium nitrate as a foliar application.

MATERIALS AND METHODS

The present investigation was carried out during two successive seasons, 2016 and 2017, on twenty years old "Le Conte" pear trees budded on *Pyrus communis* rootstock planted at 5 x 5 m apart and grown on clay loam soil under surface irrigation system, at El-Kanater Horticultural Research Station to study the effect of Ca $(NO_3)^2$ and borax (source of boron) as a foliar application on yield, leaf mineral content and fruit quality of pear trees. The trees were in normal growth, uniform in vigor and received normal fertilization and agricultural practices as scheduled in the commercial

orchard. Physical and chemical analyses of the experimental soil are illustrated in Table (1): Some physical and chemical properties for the experiment site

Table 1.

Characters	Particle size distribution (%)			Textural class	PH	Ec	O.M (%)	$CaCO_3$	Available (ppm)			
	Sand	Silt	Clay						N	P	K	B
Value	34.10	34.50	31.40	Clay Loam	7.65	0.95	1.65	2.12	37.22	8.24	314.25	0.75

The treatments were arranged in the complete randomized block with five replicates for each treatments and one tree per each replicate (9 treatments x 5 replicates x one tree = 45 trees). The nine treatments were applied as follows

T_1- Control (untreated trees)

T_2- Spraying with 1% $Ca(NO_3)^2$

T_3- Spraying with 2% $Ca(NO_3)^2$

T_4- Spraying with 100 ppm Borax

T_5- Spraying with 200 ppm Borax

T_6-Spraying with 1% $Ca(NO_3)^2$ +100 ppm Borax

T_7- Spraying with 2% $Ca(NO_3)^2$ +100 ppm Borax

T_8- Spraying with 1% $Ca(NO_3)^2$ +200 ppm Borax

T_9- Spraying with 2% $Ca(NO_3)^2$ + 200 ppm Borax

The experimental trees were sprayed three times with the previous treatments at full bloom, which was at the beginning of March, a month later and then two months from the first spray in the two seasons

The effect of the previous treatments was studied by evaluating their effect on the following parameters:

Fruit set percentage

The total number of flowers at full bloom and the initial number of fruits at the end of blooming stage on the labeled limbs in all treatments were counted and recorded then the percentage of fruit set was calculated as the following equation according to Westwood (1978) as follows:

Fruit set (%) =

$$\frac{\text{Number of set fruitlets}}{\text{Number of flowers at full bloom}} \times 100$$

Fruit yield

Tree yield was recorded at the time of harvesting; (2^{nd} week of August) and expressed as kg/ tree and tons/fed. as well as number of fruits/tree for each treatment was counted.

Fruit quality

Samples of matured ten fruits at harvesting time from each replicate were collected and the following fruit characters were determined: fruit physical properties including the average values of fruit weight (g), fruit size (cm^3), fruit length (cm) , fruit diameters (cm) and fruit firmness ($lb/inch^2$) was determined using pressure tester with 7/1 8 inch plunger (Magness and Taylor 1925). In addition, fruit chemical properties were also estimated including TSS (%) by hand refractometer, according to A.O.A.C (2000) and fruit juice titratable acidity (%) according to Vogel (1968).

Leaf and fruit mineral composition:

Twenty leaves from the middle part of the shoots were selected randomly from each replicate (at the second week of August) and fruit samples were taken at harvest time to determine their content

from N, P, K, Ca, Mg, Fe, Zn, Mn Cu and B according to Ryan *et al.,* (1996). Determination was carried out on dry weight basis.

Statistical analysis:

All the obtained data during both seasons of study were tabulated and statistically analyzed using L.S.D test at 5% level for comparing between different treatment means according to Snedecor and Cochran (1969). All statistical analysis was performed using analysis of variance technique by means of "M-STAT" computer software package.

RESULTS AND DISCUSSIONS

Fruit set percent

Results illustrated in Fig. 1 indicated that all treatments increased fruit set percentage significantly than the control especially the combined treatment 2% $Ca(No_3)^2$ + 200 ppm Borax which recorded the highest values followed by the treatment of 2% $Ca(No_3)^2$ as foliar spray compared with the lowest values obtained by control. Calcium and boron together in the same solution had a positive effect on increasing fruit set %. This may be due to the improving effect of such treatments on nutritional status which reflected on increasing fruit set and fruit retention. In this respect, Qin (1996) and Hassan (2000) reported that the improving fruit set could be explained as a result increasing pollen grains germination and pollen tube elongation due to boron treatments. Similar results were obtained by Mosa *et al.,* (2015) who indicated that the calcium nitrate significantly increased fruit set, of "Le Conte" pear trees, over control. in the same line, Sarrwy *et al.,* (2012) on date palm .

Fruit yield

Tabulated data in Table 2 reveal that the spraying calcium nitrate and boron together (1 or 2 %Ca $(NO_3)^2$ +100 or 200 ppm Borax gave the highest significant values of fruit weight (g) fruit number, fruit yield/ tree (kg) and fruit yield ton fed in both seasons. Meanwhile, sole foliar application of boron at two doses or control treatments led to significant decrease of such parameters in both ones. Increasing fruit yield due to boron and/or calcium spray may be attributed to their effect of increasing fruit set. Also, it may attribute to the role of boron in enhancing many metabolic processes such as sugars and carbohydrate transport (Mengel and Kirkby, 2001).

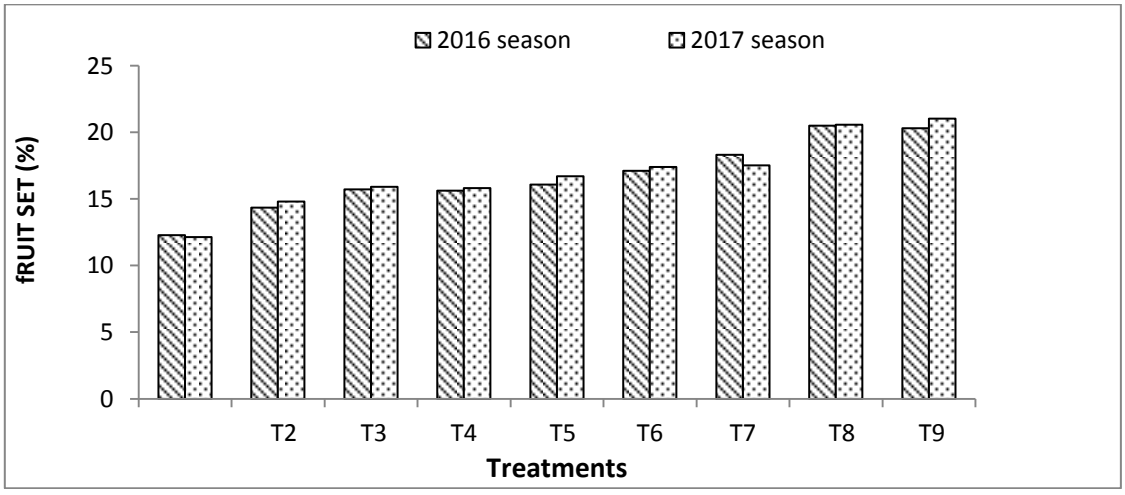

Table (2): Effect of calcium nitrate and boron as foliar application on yield and components of pear tree in 2016 and 2017 seasons.

	Fruit Weight (g)		Fruit number / tree		Fruit yield / Tree (kg)		Fruit yield ton fed^{-1}	
	2016	2017	2016	2017	2016	2017	2016	2017
T1- Control (untreated trees)	155.3	162.1	275.0	316.7	42.70	51.47	7.94	8.64
T2- Sprayying with 1% $Ca(NO_3)^2$	177.1	175.8	341.7	333.3	57.27	60.70	9.62	11.92
T3- Sprayying with 2% $Ca(NO_3)^2$	183.2	184.6	250.0	310.0	62.60	61.47	10.51	10.32
T4- Sprayying with 100 ppm Borax	173.4	172.4	250.0	310.0	43.37	53.47	7.28	8.96
T5- Sprayying with 200 ppm Borax	166.8	166.3	275.0	333.3	45.87	55.33	7.70	9.29
T6-Sprayying with 1 % $Ca(NO_3)^2$ +100 ppm Borax	206.6	206.4	275.0	336.7	56.80	69.37	9.54	11.65
T7- Sprayying with 2% $Ca(NO_3)^2$ +100 ppm Borax	19707	197.2	375.0	333.3	74.10	65.77	12.44	11.49
T8- Sprayying with 1 % $Ca(NO_3)^2$ +200 ppm Borax	193.0	202.0	375.0	320.0	72.43	64.80	12.16	10,88
T9- Sprayying with 2 % $Ca(NO_3)^2$ + 200 ppm Borax	208.9	205.4	353.3	346.7	73.83	71.20	12.40	11.96
L.S.D at 0.05	4.550	13.54	60.10	N.S	11.07	11.04	2.643	2.758

Fig. (1): Effect of calcium and boron as foliar application on fruit set % of pear trees in

2016 and 2017 seasons.

Fruit quality

Data presented in Table 3 show that the highest significant values of fruit length, size, and diameter were recorded when pear tree, variety 'Le Conte' was sprayed with calcium nitrate and boron together (1 or 2 % Ca $(NO_3)^2$ +100 or 200 ppm Borax in both seasons. The same trend was obtained for fruit number/tree in the first season only. While, the lowest ones were noticed by control treatment or 200 ppm Borax only in both seasons. Calcium is careful as one of the most essential nutrients determining the fruit quality, since it is required for cell elongation and division. Also, boron plays a vital role in many functions of the plant such as hormone movement, activate salt absorption, flowering and fruiting process and transport of sugars and carbohydrate (Khayyat *et al.,* 2007). In this connection, Merwad *et al.,* (2016); through studying the fruit quality, found that spaying Ca. and B gave a high quality comparing with the control treatment. These results confirm with Stano *et al.,* (2011) who found that foliar spray of mango trees with calcium nitrate and boric acid improved quality as well as physical and chemical mango fruit properties. Moreover, Khalifa *et al.,* (2009) showed increases in the apples sizes (*Malus domestica* Borkh) from four- year-old trees sprayed with B (as 0.025, 0.05 and 0.1% boric acid) in two seasons and that may be attributed to the physiological role of B to cell elongation and carbohydrate transport to reproductive tissues such as flowers and fruits. Concerning fruit firmness (Fig. 2) and acidity were improved significantly by foliar spray of calcium nitrate and boron together (1 or 2 % Ca $(NO_3)^2$ +100 or 200 ppm Borax or alone compared with control treatment in both seasons. Moreover, TSS was increased significantly by spraying all treatment compared to 2% Ca $(NO_3)^2$ + 100 ppm borax in the first season and 1 or 2 % Ca $(NO_3)^2$ +100 ppm Borax together and 1 % Ca $(NO_3)^2$ alone in the second one. The beneficial effect of calcium could be attributed to the physiological role of calcium which plays a binding role in the complex polysaccharides and proteins forming the cell wall. Our results are in agreement with those recorded by Casero *et al.,* (2004) and Asgharzade *et al.,* (2012) who reported that the enhancement which occurred in fruit quality with foliar application of calcium could be attributed to the effect of calcium in enhancing and advancing flowering, maturity and the translocation of carbohydrates from leaves to fruits. Also, Mosa, *et al.,* (2015) found that the foliar application of calcium nitrate at 1% had the highest beneficial effect to increase fruit set percentages, yield, fruit firmness and acidity in the fruit and to decrease fruit drop percentages of "Le Conte" pear trees compared with the control and the other treatments.

Nutrition status

Leaf mineral contents (N, P, K, Ca and Mg)

Results in Table 4 reveal that spraying 1 or 2% Ca $(NO_3)^2$ alone gave the highest significant value of N % for pear leaves in both seasons. As well, P % was improved significantly using 2% Ca $(NO_3)^2$ +200 ppm borax in two seasons. Also, K, Ca and Mg percentage were increased significantly with spraying 100 ppm boron + 2 % Ca NO_3. On the other hand, the lowest significant values of all parameters were with control treatment in both seasons. Similar trend of the lowest uptakes was recorded for K and Ca content by foliar application of 2% Ca (NO3)2 in the first season only. The obtained results are in harmony with those obtained by Sarrwy *et al.,* (2012) on date palm, Mosa *et al.,* (2015) on pear trees Hikal *et al.,* (2017) on Navel orange, who stated that the foliar application of

Table (3): Effect of calcium nitrate and boron as foliar application on fruit quality characters of pear fruits in 2016 and 2017 seasons.

Treatments	Fruit Length (cm)		Fruit diameter (cm)		Fruit size(cm^3)		TSS (%)		Acidity%	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
T1- Control (untreated trees)	7.733	7.647	6.183	6.210	154.8	156.7	12.50	12.50	0.667	0..773
T2- Spraying with 1% $Ca(NO_3)^2$	7.980	8.063	6.653	6.803	180.8	181.7	12.67	12.00	0.667	0.737
T3- Spraying with 2% $Ca(NO_3)^2$	8.226	8.223	6.753	6.817	182.2	183.3	12.67	12.33	0.600	0.767
T4- Spraying with 100 ppm Borax	7.757	7.787	6.457	6.530	170.0	170.0	12.83	12.50	0.700	0.753
T5- Spraying with 200 ppm Borax	7.567	7.620	6.283	6.347	163.8	167.0	12.82	12.33	0.633	0.733
T6-Spraying with 1 % $Ca(NO_3)^2$ +100 ppm Borax	8.387	8.440	7.157	7.217	202.2	208.0	12.67	11.83	0.700	0.750
T7- Spraying with 2% $Ca(NO_3)2$ +100 ppm Borax	8.150	8.253	6.293	7.017	198.3	198.7	11.67	12.00	0.733	0.767
T8- Spraying with 1 % $Ca(NO_3)$ 2 +200 ppm Borax	8.463	8.353	6.923	7.027	202.5	202.7	12.00	12.33	0.800	0.800
T9- Spraying with 2 % $Ca(NO_3)2$ + 200 ppm Borax	8.327	8.410	7.140	7.117	206.7	208.3	12.67	12.83	0.667	0.733
LSD at 0.05	0.595	0.508	0.359	0.310	15.40	10.82	0.823	0.808	0.134	0.055

calcium nitrate significantly improved N, P. Ca and Mg content in the leaves over control treatment .

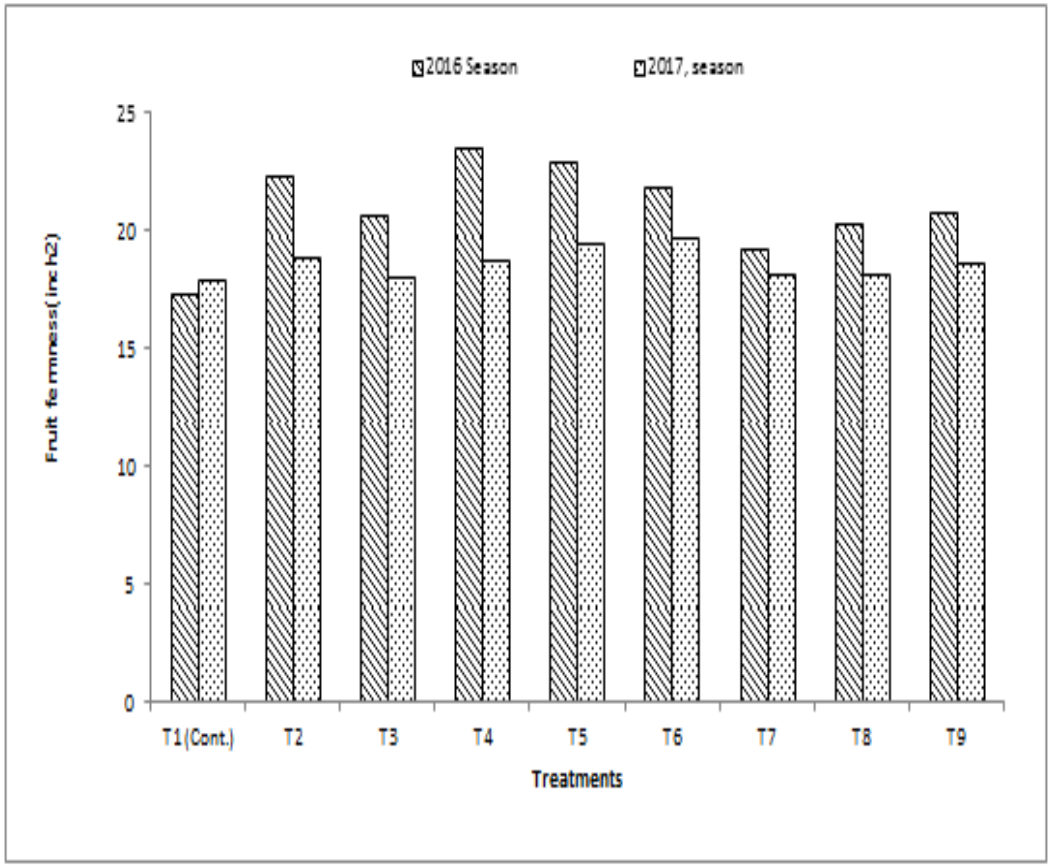

Fig. (2): Effect of calcium and boron as foliar application on fruit firmness of pear fruits in 2016 and 2017 seasons.

Table (4): Effect of calcium nitrate and boron as foliar application on N, P, K, Ca and Mg contents of pear leaves in 2016 and 2017 seasons.

Treatments	N (mg kg)		P mg kg		K(mg kg)		Ca (mg kg)		Mg (mg kg^{1}	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
T1- Control (untreated trees)	1.710	1.670	0.212	0.217	0.676	0.676	1.540	1.296	0.48	0.42
T2- Spraying with 1% $Ca(NO_3)^2$	2.317	2.380	0.306	0.306	0.958	1.022	1.609	1.609	0.46	0.46
T3- Spraying with 2% $Ca(NO_3)^2$	2.987	2.970	0.327	0.274	0.873	0.828	2.070	2.311	0.57	0.59
T4- Spraying with 100 ppm Borax	2.747	2.687	0.335	0.316	1.036	1.060	2.385	2.441	0.69	0.64
T5- Spraying with 200 ppm Borax	2.910	2.900	0.268	0.235	1.131	1.158	2.112	3.199	0.61	0.56
T6-Spraying with 1 % $Ca(NO_3)^2$ +100 ppm Borax	2.760	2.800	0.310	0.221	1.370	1.188	2.930	2.757	0.69	0.53
T7- Spraying with 2% $Ca(NO_3)2$ +100 ppm Borax	2.730	2.797	0.348	0.334	1.855	1.472	3.660	3.521	0.79	0.82
T8- Spraying with 1 % $Ca(NO_3)$ 2 +200 ppm Borax	2.087	2.300	0.226	0.224	1.025	0.989	2.273	2.259	0.60	0.56
T9- Spraying with 2 % $Ca(NO_3)2$ + 200 ppm Borax	2.670	2.750	0.409	0.416	1.473	1.310	3.404	2.817	0.66	0.17
L SD at 0.05	0.145	0.077	0.0017	0.0017	0.355	0.122	1.631	0.305	0.017	0.017

Leaf mineral contents (Fe, Zn, Mn, Cu and B)

Results in Table 5 reveal that, in most cases, Fe and Zn contents of pear leaves were increased significantly by spraying 2 % Ca $(NO_3)^2$ +100 and 200 ppm borax or 100 ppm boron alone in both seasons. Mn content was enhanced with spraying 1% Ca $(NO_3)^2$ +100 ppm borax or 2 % Ca $(NO_3)^2$ +200 ppm boron + in both seasons. Also, 2% Ca $(NO_3)^2$ + 200 ppm borax + 1 % Ca $(NO_3)^2$ or alone gave the highest significant value of Cu content in both seasons. Whereas, spraying l00 ppm boron + 1 % Ca $(NO_3)^2$ or 200 ppm boron + 2 % Ca $(NO_3)^2$ together or 2 % Ca (NO3)2 alone led to incease leaf B content. In contrast, the lowest significant values of all parameters in Table 5 were noticed with control treatment in both seasons. Similar trend was recorded for Cu content by foliar application of 2 % Ca $(NO_3)^2$ in the first season only. The obtained data are in the same trend with the findings of Hanson, 1991, Fry, 2004 and Mosa, *et al.,* (2015).

Fruit mineral contents (N, P, K, Ca and Mg)

Results in Table 6 illustrate that the spraying of 2 % Ca $(NO_3)^2$, 100 or 200 ppm B and 2 % Ca $(NO_3)^2$ +100 ppm B gave the highest significant value of nitrogen content in pear fruit comparable to the other treatments, in both seasons. Fruit P content was improved by foliar spray of 100 ppm B alone in both seasons. K content in pear fruit was improved significantly with spraying of 200 ppm B compared to the other treatments in both seasons. With regard to fruit calcium and magnesium contents, results show that foliar application of 2% Ca $(NO_3)^2$ alone gave the highest significant values of such nutrients of pear fruit in both seasons. While, 200 ppm boron with 2% Ca $(NO_3)^2$led to significant increase of Mg content only in both ones. Conversely, the lowest significant values of the abovementioned elements were occurred by control treatment in two seasons. The obtained results are in the same trend with the findings of Hanson, 1991 who found that the foliar application of boron was highly effective in improving, nutritional status, yield and quality of pear and apple trees. Also, the recorded data are in harmony with those obtained by Abo El-Enien, (2012), Mosa, *et al.,* (2015) and White and Brodadly, (2003).

Fe, Zn, Mn, Cu and B content of pear fruits

Available data in Table 7 show that single spraying 1 % Ca $(NO_3)^2$ improved significantly of Fe and B contents in pear fruits, while foliar application of boron with the concentration of 100 ppm increased significantly Zn content in both seasons, respectively. Also, Mn content was increased significantly with foliar application of 200 ppm boron only. Moreover, 2 % Ca $(NO_3)^2$ with 100 or 200 ppm B enhanced Cu content in both ones. Alternatively, the lowest significant values of Fe. Zn. Mn, Cu and B content were observed with control treatment in both seasons. Similar trend was recorded for Fe and Zn content by foliar application of 1 % Ca $(NO_3)^2$ +100 ppm B and + 1 % Ca $(NO_3)^2$ +200 ppm B in both seasons, respectively, in addition, Cu content under foliar application of 1 % Ca $(NO_3)^2$in the first season only. The obtained data are in the same trend with the findings of Hanson, 1991 and Mosa *et al.*)., 2015.

Table (5): Effect of calcium and boron as foliar application on Fe, Zn, Mn, Cu and B contents of pear leaves in 2016 and 2017 seasons

Treatments	Fe ppm		Zn ppm		Mn ppm		Cu ppm		B ppm	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
T1- Control (untreated trees)	349.3	290.0	46.52	58.67	38.64	37.29	7.10	8.35	20.37	19.58
T2- 1% $Ca(NO_3)^2$	700.7	734.0	58.67	71.39	46.52	46.52	35.58	35.58	90.97	90.97
T3- 2% $Ca(NO_3)^2$	472.0	474.0	76.33	80.68	66.68	56.52	8.91	9.45	109.2	97.00
T4- 100 ppm Borax	860.3	878.3	86.17	88.90	65.35	69.02	13.05	16.08	23.33	26.17
T5- 200 ppm Borax	805.0	837.0	61.00	68.17	54.85	60.13	16.23	18.08	25.00	27.13
T6- 1 % $Ca(NO_3)^2$ +100 ppm Borax	430.7	345.0	62.83	69.83	74.52	107.50	27.92	27.42	116.7	106.8
T7- 2% $Ca(NO_3)2$ +100 ppm Borax	860.7	831.7	82.50	82.83	66.52	76.52	17.57	17.58	81.00	82.33
T8- 1 % $Ca(NO_3)$ 2 +200 ppm Borax	353.3	367.3	66.17	67.50	46.35	65.02	24.97	23.76	83.00	85.33
T9- 2 % $Ca(NO_3)2$ + 200 ppm B	758.3	930.7	74.00	80.43	94.85	103.90	38.15	37.70	81.67	101.7
L SD at 0.05	121.2	88.10	10.15	11.61	7.434	14.98	4.870	4.158	13.88	15.41

Table (6): Effect of calcium nitrate and boron as foliar application on N, P, K, Ca and Mg contents of pear fruits in 2016 and 2017 seasons

Treatments	N mg kg^{-1}		P mg kg^{-1}		K mg kg^{-1}		Ca mg kg^{-1}		Mg mg kg^{-1}	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
T1- Control (untreated trees)	0.557	0.560	0.027	0.027	0.337	0.350	0.029	0.028	0.014	0.014
T2- 1% $Ca(NO_3)^2$	0.677	0.717	0.042	0.042	0.307	0.327	0.060	0.060	0.017	0.017
T3- 2% $Ca(NO_3)^2$	0.990	0.970	0.049	0.049	0.367	0.377	0.079	0.079	0.026	0.025
T4- 100 ppm Borax	0.917	0.910	0.054	0.052	0.347	0.377	0.040	0.041	0.018	0.085
T5- 200 ppm Borax	0.960	0.977	0.041	0.054	0.400	0.407	0.047	0.048	0.016	0.019
T6- 1 % $Ca(NO_3)^2$ +100 ppm Borax	0.900	0.910	0.044	0.045	0.347	0.327	0.034	0.034	0.016	0.017
T7- 2% $Ca(NO_3)2$ +100 ppm Borax	0.917	0.930	0.048	0.049	0.297	0.277	0.066	0.066	0.018	0.017
T8- 1 % $Ca(NO_3)$ 2 +200 ppm Borax	0.690	0.720	0.042	0.041	0.377	0.397	0.035	0.033	0.020	0.019
T9- 2 % $Ca(NO_3)2$ + 200 ppm Borax	0.887	0.877	0.044	0.044	0.320	0.330	0.044	0.045	0.026	0.026

L SD at 0.05	0.077	0.055	0.002	0.002	0.0017	0.0017	0.0017	0.0017	0.002	0.002

Table (7): Effect of calcium nitrate and boron as foliar application on Fe, Zn, Mn, Cu and B contents of pear fruits in both seasons.

Treatments	Fe ppm		Zn ppm		Mn ppm		Cu ppm		B ppm	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
T1- Control (untreated trees)	172.9	164.1	0.45	0.43	2.36	2.53	0.18	0.18	2.84	2.35
T2- 1% $Ca(NO_3)^2$	230.3	230.3	0.96	0.98	4.23	4.23	0.41	0.44	6.85	6.56
T3 2% $Ca(NO_3)^2$	161.1	161.2	0.71	0.77	4.13	4.27	0.23	0.40	3.93	3.399
T4- 100 ppm Borax	163.4	170.9	0.43	1.58	3.47	3.17	1.64	1.79	5.58	5.5.28
T5- 200 ppm Borax	187.5	181.9	0.78	0.83	7.66	7.79	0.84	1.07	5.52	5.66
T6- 1 % $Ca(NO_3)^2$ +100 ppm Borax	155.1	153.8	0.50	0.55	3.10	3.65	1.43	1.49	4.87	5.00
T7- 2% $Ca(NO_3)2$ +100 ppm Borax	160.9	170.4	0.59	0.83	3.56	3.25	2.58	2.72	4.16	3.85
T8- 1 % $Ca(NO_3)$ 2 +200 ppm Borax	178.8	180.2	0.44	0.59	3.42	3.70	1.15	1.29	5.82	6.10
T9- 2 % $Ca(NO_3)2$ + 200 ppm Borax	190.0	201.0	0.80	0.85	3.75	3.88	2.28	2.13	5.24	5.38

Conclusion

Based on the results obtained from this study, it is concluded that spraying Le Conte' pear trees with boron and calcium nitrate as individual or in combination had a positive effect on fruit set, yield and fruit quality. However, the best treatment is spraying boron at 200 ppm in combination with calcium nitrate at 2% since it gave the highest values concerning fruit set, retention, weight and yield, also. fruit physical and chemical characteristics as well as nutritional status of leaves and pear fruits.

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تأثير الرش الكالسيوم والبورون علي انتاجية اشجار الكمثري صنف ليكونت

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الملخص العربي

اجريت هذة الدراسه خلال موسمي ٢٠١٦ و٢٠١٧ في مزرعة محطة بحوث البساتين بالقناطر – القليوبيه– مصر بهدف دراسة استجابة اشجار الكمثري ليكونت لمعاملات الرش الكالسيوم والبورون فى ٩ معاملات للرش علي الاشجار كالتالي ١و ٢% نترات الكالسيوم و ١٠٠ و ٢٠٠ جزء في المليون بوراكس و ١% نترات الكالسيوم+ ١٠٠ جزء في المليون بوراكس و١% نترات الكالسيوم+ ١٠٠ جزء في المليون بوراكس و٢% نترات الكالسيوم+ ٢٠٠ جزء في المليون بوراكس و٢% نترات الكالسيوم+ ٢٠٠ جزء في المليون بوراكس بالاضافه الي معاملة الكنترول وهو الرش بالماء فقط على المحصول وجودة الثمار.

ويمكن تلخيص النتائج المتحصل عليها فيما يلي:-

سجلت معاملة الرش المركبة ٢% نترات الكالسيوم + ٢٠٠ جزء في المليون بورن تليها المعاملة ٢% نترات الكالسيوم + ١٠٠ جزء في المليون افضل النتائج حيث ادت الي زياده معنويه في نسبة عقد الثمار والمحصول وجودة الثمار خاصة صلابة الثمار ومحتواها من الماد الصلبة الذائبة ومحتوي الاوراق من العناصر وجودة الثمار مقارنه بالمعاملات الاخري والكنترول خلال موسمي الدراسه .

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