

The influence of some plant growth regulators and calcium nitrate on growth, yield and fruit quality of "Le Conte" pear trees.

Abstract

This experiment was carried out during two successive seasons, 2012 and 2013, on 8 years old "Le Conte" pear budded on *Pyrus communis* L. rootstock. The trees were grown in sandy loam soil in a private orchard located at Burg EL-Arab, Alexandria governorate, Egypt. The trees were sprayed with water only (control treatment), NAA at 50 and 100 ppm, GA₃ at 50 and 100 ppm and calcium nitrate at 0.5 % and 1 %, three times at full bloom, the start of march, one and two months after full bloom. Generally, the obtained results showed that the foliar application of NAA, GA₃ and calcium nitrate improved significantly shoot length and thickness, leaf area, fruit set and fruit yield. Additionally, they gave a remarkable increase in weight, size and firmness of fruits and N, P, Ca and Mg content in the leaves, as compared to the control. Among all the used treatments, calcium nitrate at 1 % had the most beneficial effect. It caused the most remarkable increase in fruit set percentages, yield (kg/tree), yield (ton/hectare), fruit firmness, acidity and vitamin C content. Moreover, it decreased significantly fruit drop percentages, as compared to the control and the other treatments in both seasons.

Key words: Le Conte pear; NAA; GA₃; yield; fruit quality

Introduction

Pear (*Pyrus communis* L.) is a popular fruit in temperate regions and one of the most important deciduous fruits in Egypt. The main pear cultivar in Egypt is "Le Conte", which is a hybrid between *Pyrus communis* L. X *Pyrus serotina* L. Gibberellins promote seed germination, stimulate stem elongation, leaf expansion, flowering, pollen and seed development and delay fruit ripening (Rosenwasser *et al.*, 2006). Auxins such as NAA have been used since a long time to improve fruit quantity and quality in many deciduous fruit tree. They control fruit development (Acquaah, 2005). The foliar application with GA₃ increased weight, volume and length of "Amrapali" mango fruits, because it helps to multiply and lengthen the meristem cells (Sarkar and Ghosh, 2005). Gupta and Kaur (2007) noted that spraying "Satluj purple" plum with 10 and 20 ppm NAA at different stages of fruit development, increased fruit yield due to the more retention and increase of fruit size. Additionally, they increased significantly fruit weight and total soluble solid. The use of plant growth regulators such as NAA and GA₃ reduced flower drop, gave a high flower retention and increased yield and fruit quality in mango and other fruit species such as citrus, apple and guava (Iqbal *et al.*, 2009). Al-Bamarny *et al* (2010) investigated the effect of NAA (0-5mg.l) on the growth and fruit characteristics of "Early Coronet" peach cultivar. The results showed that raising the levels of NAA to 5 mg.l increased significantly number, length and diameter of fruits and shoot dry weight, as compared with untreated trees. Nkansah *et al.* (2012) investigated the the effect of GA₃ and NAA sprays on fruit retention, fruit quality and yield of "Keitt" mango trees at full bloom stage. The results proved that 25 ppm from GA₃ or NAA increased significantly fruit set, fruit retention, number of fruits per cluster and per plant, fruit weight and yield in both seasons. Świątkiewicz and Błaszczyk (2009) studied the effect of early spraying, beginning of June, with 0.4 % and late spraying in August, about 30 days before the harvest, with 0.8 % of Ca(NO₃)₂ on storability and calcium content, as well as elemental mutual relations in 'Elise' fruit of a 5-year-old apple tree. The trees were sprayed 3 times at 10 day intervals in the first time of fruit development, beginning of June and 30 days before fruit harvest. Fruit mineral

composition was estimated after harvest. The obtained results indicated clearly that the foliar sprayings with calcium before harvesting, 30 days before, increased Ca concentration and decreased significantly N/Ca and K/Ca ratios in fruits in both years. Fruits treated with $\text{Ca}(\text{NO}_3)_2$ had higher flesh firmness and titratable acidity than the control ones. Sarrwy *et al* (2012) investigated the impact of spraying with 1 and/or 2 % calcium nitrate on "Amhat" date palm. The results indicated that spraying date palm inflorescence with calcium nitrate increased significantly fruit set, fruit retention, fruit yield and length, diameter, weight and volume of fruit.

The aim of this study was to investigate the effect of gibberellic acid, naphthalene acetic acid and calcium nitrate on vegetative growth parameters, fruit set, yield, fruit quality and leaf mineral content of "Le Conte" pear trees.

Materials and Methods

The present investigation was carried out during two successive seasons 2012 and 2013 on "Le Conte" pear trees which is a hybrid between *Pyrus communis* L. X *Pyrus serotina* L. The trees were of 8 years old at the start of the experiment, budded on *Pyrus communis* rootstock. They were planted at 5 × 5 m apart and grown on sandy loam soil in a private orchard located at Burg EL-Arab, Alexandria governorate, Egypt. They were in normal growth, uniform in vigour and received normal fertilization and agricultural practices as scheduled in the commercial farm.

Physical and chemical analysis of the experimental soil are illustrated in Table (1). The results indicated that the soil orchard texture is good for pear trees cultivation.

The trees were sprayed three times at full bloom, start of March, one and two months after full bloom in the two seasons with the following treatments:

- Water only (control),
- Naphthalene acetic acid at 50 ppm,
- Naphthalene acetic acid at 100 ppm,
- Gibberellic acid at 50 ppm,
- Gibberellic acid at 100 ppm,
- Calcium nitrate at 0.5 %,
- Calcium nitrate at 1 %.

Thirty five uniform trees were selected for the present study. The treatments were applied and arranged in a randomized complete block design. Each treatment included five replicates with one tree for each replicate. The effect of the previous treatments was studied by evaluating their influence on the following parameters.

Vegetative growth parameters

Four main and uniform branches were chosen and tagged at four cardinal points of each treated tree, and the average of their shoot length in cm and thickness in cm were measured in October, in the two studied seasons.

Twenty mature leaves were collected randomly from each replicat to determine leaf area in cm^2 by using leaf area meter model (1203, CID, Inc, USA).

Flowering and fruiting

Four branches, in the different sides of each replicat were tagged for determining the fruit set and fruit drop percentages. Fruit set was caclulated according to Westwood (1988) equation

$$\text{Fruit set \%} = \frac{\text{Number of set fruitlets}}{\text{Number of opened flowers}} \times 100$$

Furthermore, the number of dropped fruits were recorded till harvest time, then estimated as percentage on the basis of initial number of fruitlets according to this equation

$$\text{Fruit drop \%} = \frac{\text{Number of dropped fruitlets}}{\text{Number of set fruitlets}} \times 100$$

Yield per tree

Fruit yield on each replicate resulting from applied treatments was expressed as the weight of fruits in kg per tree which was attained at harvest stage, second week of August.

Yield (ton/hectar) was expressed by multiplying the weight of fruits per tree $\times$ number of trees/hectar.

Fruit weight (g/fruit) was calculated as the average of twenty randomly selected fruit from each replicate.

Fruit quality

Twenty fruits from each replicate were chosen randomly for determination physical and chemical characteristics.

Fruit physical characteristics

- Fruit weight (g), fruit length (cm) and fruit diameter (cm)
- Fruit firmness was estimated by Magness and Taylor pressure tester, which has a standard 5/16 of inch plunger and recorded as lb/inch².

Fruit chemical characteristics

- Total soluble solids (TSS) was determined by a hand refractometer,
- Acidity of fruit juice was determined as malic acid by titration with 0.1 normal sodium hydroxide with phenolphthalein as in indicators, according to A.O.A.C., 1992,
- TSS/ acid ratios were calculated for each replicate of the applied treatments,
- Vitamin C (Ascorbic acid) was determined by titration with 2,6-dichloroindophenol (A.O.A.C, 1992) and calculated as milli-grams per 100 ml of juice,
- Total sugar were determined according to Malik and Singh (1980). They were extracted from 5 gram fresh weight and determined by phenol sulfuric and Nelson arsenate-molybdate colorimetric methods for total sugars.

Leaf mineral compositions

Twenty leaves from the middle part of the shoots (according to Chuntanaparb and Cummings, 1981) were selected randomly from each replicate (at the second week of June) to determined their content of N, P, K, Ca and Mg percentages (according to Wilde *et al.*, 1985). Determination were carried out on dry weight basis.

Statistical analysis

The obtained data were subjected to the proper analysis of variance (ANOVA) according to Snedecor and Cochran (1980). Least significant difference (LSD) at 0.05 % level of significance was used to compare the treatment means.

Results

Data in the  e 2 showed that the spray of the trees with GA₃ at 100 ppm and/or calcium nitrate at 1 % increased significantly shoot length, shoot thickness and leaf area in both seasons, as compared to the control. GA₃ at 50 ppm enhanced significantly shoot length and leaf area in the first season and in both seasons respectively, as compared to the control. NAA at 50 and/or 100 ppm, GA₃ at 50 ppm and calcium nitrate at 0.5 % improved significantly shoot thickness in the two seasons, as compared to the control. The treatments of NAA at 50 and/or 100 ppm and calcium nitrate at 0.5 % gave a slight increase which was insignificant in shoot length or leaf area, as compared to the control in both study seasons.

From the data listed in the table 3, it can be concluded that the application of NAA or GA₃ at 50 ppm and calcium nitrate treatments at 0.5 % or 1 % gave a remarkable increase in fruit set

percentages, yield in kg/tree and yield in ton/hectar, over the control in the two seasons. On the opposite side, the treatments of NAA or GA₃ at 100 ppm did not give any significant increase in fruit set percentages, yield in kg/tree and yield in ton/hectar, as compared to the control in the two seasons. Calcium nitrate at 1 % had the highest positive effect to reduce fruit drop percentages in the two seasons, as compared to the control. NAA or GA₃ at 50 ppm, and calcium nitrate at 0.5 % decreased significantly the percentages of fruit drop in the second year, as compared to the control. On the opposite side, NAA or GA₃ at 100 ppm did not have any remarkable effect on reduction in fruit drop percentages in the two seasons, as compared to the control.

Data in the table 4 showed that NAA at 50 /or 100 ppm, GA₃ at 50 /or 100 ppm and calcium nitrate at 0.5 % /or 1 % increased significantly fruit weight and fruit diameter, as compared to the control in the two seasons. The treatments of NAA at 50 and/or 100 ppm and GA₃ at 50 and/or 100 ppm gave also, significant increases in fruit length in both seasons, as compared to the control. GA₃ at 50 and/or 100 ppm and calcium nitrate at 0.5 % and/or 1% enhanced significantly fruit firmness in the two seasons, as compared to the control. Calcium nitrate at 0.5 % and/ or 1 % improved significantly fruit length in the second season, but in the first season, they gave non remarkable increase, as compared to the control. NAA at 50 and/or 100 ppm treatments gave a slight increase, which was not enough to be significant in fruit firmness in the two seasons, as compared to the control.

Data in the table indicate that GA₃ at 50 and/or 100 ppm and calcium nitrate at 0.5 % and/or 1 % improved significantly vitamin C content in the fruits, as compared to the control in both study seasons. NAA at 50 and/or 100 ppm gave insignificant increase in vitamin C content in the fruits in the two seasons as compared to the control. GA₃ at 100 ppm and calcium nitrate at 0.5 % and/or 1 % increased significantly the acidity in the fruits in the two seasons, as compared to the control. GA₃ at 50 ppm in the first season increased significantly the acidity in the fruits but in the second season, the enhancement was not significant in comparison to the control. On the opposite side, NAA at 50 ppm and /or 100 ppm gave insignificant increase in the acidity in the two seasons, as compared to the control. GA₃ at 100 ppm and calcium nitrate at 0.5 % and/or 1 % decreased significantly TSS/acid ratio in the two seasons, as compared to the control. GA₃ at 50 ppm and NAA at 50 and/or at 100 ppm decreased slightly TSS/ acid ratio in the two seasons, as compared to the control. All the treatments did not have any significant effect on the percentages of total soluble solids or total sugar content in the two seasons, as compared to the control.

Data in the table 6 showed that GA₃ at 100 ppm and calcium nitrate at 0.5 % and/or 1 % improved significantly nitrogen, phosphours and magnesium content in the leaves, over the control in the two seasons. NAA at 50 and/or 100 ppm and GA₃ at 50 ppm also, increased significantly nitrogen and phosphours but, they gave non remarkable increase in magnesium content in the leaves in the two seasons, as compared to the control. Calcium content in the leaves was improved significantly by the usage of NAA at 100 ppm and calcium nitrate at 0.5 % and/or 1 % in the two seasons in comparison to the control. NAA at 50 ppm and GA₃ at 50 ppm increased slightly calcium content in the leaves. All the treatments gave a negative effect on decrease in potassium content in the leaves, as compared to the control in both study seasons.

Discussion

Our results proved that the foliar application of GA₃ improved significantly fruit weight, size and firmness of "Le Conte" pear trees. Moreover, it increased the acidity in the fruits and this explains why it delayed the ripening of them. These results are in parallel with the findings of

Sher-Muhammad *et al.* (1996). They stated that gibberellic acid was found to delay ripening and senescence of fruits, as well as fruit maturity in peaches. Kappel and MacDonald (2002) also, mentioned that sweet cherries (*Prunus avium* L.) titratable acidity of GA₃- treated fruit was significantly higher than that of untreated fruit and could be harvested later. Moreover, the treated fruit were significantly firmer and larger than untreated fruit. The increasing in fruit size by GA₃ treatment was explained by Richard (2006). The author proposed that gibberellins promote growth by increasing plasticity of the cell wall followed the hydrolysis of starch to sugar which reduces the water potential in the cell, resulting in the entry of water into the cell then causing elongation. Our results also showed that GA₃ improved significantly fruit set and yield in percentage, yield in kg/tree and leaf mineral contents and decreased significantly fruit drop percentage. These results agree with the findings of Kabeel and Fawaaz (2005). They studied the effect of the spraying with some growth regulators on "Le Conte" pear trees productivity, fruit quality and leaf mineral content during 2002 and 2003 years. The obtained results indicated that gibberellic acid gave significant increases in fruit set, yield in kg/tree and yield in percentage, and decreased significantly fruit drop, in comparison with the control in both seasons. Furthermore, it gave a remarkable improvement in fruit characteristics, e. g. fruit weight, size, dimensions, firmness, acidity, and leaf mineral contents, as compared to the control. Furthermore, our results are consistent with the findings of Kundu *et al.* (2013). They studied the effect of plant bio-regulators on fruit growth, quality and productivity of "Gola" pear (*Pyrus pyrifolia*) Brum. Nakai) under tarai condition. They found that the foliar application of gibberellic acid had a significant effect on reducing fruit drop and improving fruit growth, fruit quality and productivity, as compared to the control.

Generally, our results showed the positive effects of NAA on fruit set, yield, vegetative growth and fruit quality of "Le Conte" pear trees. These data coincided with the obtained results by Clayton *et al.* (2000). They stated that NAA, a synthetic auxin, is used commercially on California "Bartlett" pears to reduce premature fruit drop, although it can induce ethylene production and fruit softening on the tree. Furthermore, Iqbal *et al.* (2009) reported that NAA reduced significantly preharvest fruit drop and increased yield and fruit quality of guava. Our results also, are in agreement with the findings of Kassem *et al.* (2010), who found that spraying "Costata" persimmon trees with NAA increased significantly vegetative growth, fruit retention, fruit weight and tree yield in both seasons, as compared to the control. Additionally, the authors noticed that NAA increased also, total soluble solids, total sugars and vitamin C content in the fruits and decreased fruit acidity, as compared to the control in both seasons. These results do not agree with our results, where NAA had no significant effect on these parameters, as compared to the control in the two seasons. Our results showed clearly that NAA increased fruit acidity and this explain why it delayed the ripening of fruits and these data are in parallel with the findings of Antonio and Bettio (2003). They concluded that treating "Diamante" peaches by 30 mg. L⁻¹ NAA delayed the fruit harvesting time. NAA improved significantly weight and size of fruits and this results coincided with the findings of Chen *et al.* (2012). They stated that application of NAA 20 mg/L at young fruit period, enhanced fruit growth and improved final fruit size of pear.

It could be easily observed from our results that calcium nitrate improved significantly fruit set, yield, fruit quality and leaf mineral content of "Le Conte" pear trees, over the control in the two seasons. These findings are in parallel with the findings of Faust (1989). He found that calcium might be the most important mineral element determining the quality of fruit, particularly in apples and pears, because these fruits are stored for long periods of time. Pre and postharvest application of Ca is effective in maintaining quality and delaying senescence in many fruits. It helps also, to retain fruit firmness and increase vitamin C content in apple (Na Phun *et al.*, 1997). Moreover, Rizzi and Abruzzes (1998) mentioned that calcium is considered as one of the most important minerals determining the quality of fruit, since it is required for cell

elongation and cell division. İrget *et al.* (1999) investigated the effects of foliar calcium nitrate applications on nutrient content and fruit quality of figs. The trial was performed as three replications on "Sanlop" trees. The foliar fertilization was made twice on 10 and 25 July by calcium nitrate at 1.5 and 3.0 % levels and a combined application of 2.0 % potassium nitrate and 2.0 % calcium nitrate. The results put forth an increase of K and Ca contents of leaf lamina and petiole and exerted marked effect on fruit width, length, shape and width of the ostiolar opening. Calcium has received also, a considerable attention in improving production of apple trees not only due to its relationship to physiological disorders, but also due to its other desirable effects, like extending storage life and increasing firmness (Ashour, 2000). Abdel Hafeez *et al.* (2010) studied the effect of some sources of potassium and calcium as a foliar spray on fruit quality and storability of "Kelsey" plums. $\text{Ca}(\text{NO}_3)_2$ was applied as foliar spray three times a year: before flowering, 10 days after full bloom and one month later, through 2007 and 2008 seasons. The obtained results revealed that $\text{Ca}(\text{NO}_3)_2$ recorded the highest significant values in fruit set, leaf content of N and Ca, retained fruits, fruit weight and tree yield, over the control and other applied treatments. Calcium plays an important role in regulating the metabolism in apple fruit, adequate concentration maintains fruit firmness and delays fruit ripening (Demuth and Sundrud, 2012). Furthermore, Kazemi (2014) mentioned that the beneficial effect of calcium in increasing fruit set might be due to the higher availability of photosynthesis and these chemicals are also associated with hormone metabolism, which promotes synthesis of auxins, essential for fruit set and growth.

Conclusion

- The foliar application of calcium nitrate at 1 % was the most beneficial treatment for the vegetative growth and yielding of "Le Come" pear trees, as compared to the control and the other treatments in the two studied seasons.
- Treatment with calcium nitrate at 1 % gave the highest significant results in increasing fruit set percentages, yield in kg/ tree, fruit firmness, yield in ton/hectar, acidity and vitamin C content in the fruit and decreasing fruit drop percentages.
- Treatments with GA_3 and NAA improved to a lesser extent vegetative growth, fruit set, yield, fruit quality and mineral content of the leaves, as compared to the control in the two studied seasons.

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Table 1 Physical and chemical characters of experimental orchard soil

Depth (cm)	E.C dS/m	pH	CaCO ₃	Cations (meq/ L)				Anions (meq/ L)			Sand	Silt	Clay	Texture
				Ca ⁺⁺	Mg ⁺⁺	Na ⁺⁺	K ⁺	HCO ₃ ⁻	Cl ⁻	SO ₄ ⁻				
0 – 30	0.78	7.6	20.26	6.36	3.81	6.09	0.52	11.32	5.5	4.1	69.37	12.4	18.23	Sandy loam
30 – 60	1.02	7.58	22.36	6.17	5.27	7.36	1.27	9.85	6.12	3.46	70.64	8.93	20.43	Sandy loam

Table 2 Effect of some plant growth regulators and calcium nitrate on vegetative growth of "Le Conte" pear trees during 2012 and 2013 seasons.

Treatments	Shoot length (cm)		Shoot thickness (cm)		Leaf area (cm ²)	
	2012	2013	2012	2013	2012	2013
Control	42.25d	42.67 c	0.68 d	0.75 e	24.11 c	24.85 e
NAA at 50 ppm	42.36 d	43.27 c	0.71 c	0.78 d	24.25 c	25.64 de
NAA at 100 ppm	42.53 d	43.57 c	0.72 c	0.79 d	24.46 c	25.74 cde
GA ₃ at 50 ppm	43.75 c	44.12 bc	0.76 b	0.82 c	25.92 b	26.17 bcd
GA ₃ at 100 ppm	45.78 a	46.08 a	0.87 a	0.89 b	27.18 a	27.86 a
Calcium nitrate 0.5 %	42.87 d	43.54 c	0.78 b	0.80 cd	24.62 c	25.73 cde
Calcium nitrate 1 %	44.65 b	44.85 b	0.89 a	0.92 a	26.46 ab	26.73 bc

Means not sharing the same letter(s) with in each column, significantly different at 0.05 level of probability.

Table 3 Effect of some plant growth regulators and calcium nitrate on fruit set, fruit drop and yield of "Le Conte" pear trees during 2012 and 2013 seasons.

Treatments	Fruit set (%)		Fruit drop (%)		Yield (kg/ tree)		Yield (ton/ hectar)	
	2012	2013	2012	2013	2012	2013	2012	2013
Control	8.14 c	9.64 c	80.27 a	81.36 a	30.46 c	31.27 c	12.29 c	12.6 c
NAA at 50 ppm	9.36 b	9.85 b	78.65 a	77.63 b	38.56 b	40.34 b	15.55 b	16.27 b
NAA at 100 ppm	7.96 c	8.14 c	79.85 a	81.17 a	29.37 c	30.39 c	11.83 c	12.26 c
GA ₃ at 50 ppm	10.24 b	10.47 b	79.35 a	78.47 b	43.64 a	45.73 a	17.59 a	18.43 a
GA ₃ at 100 ppm	8.05 c	8.12 c	80.95 a	82.14 a	29.65 c	30.81 c	11.95 c	12.43 c
Calcium nitrate 0.5%	9.25 b	9.75 b	78.14 a	78.25 b	37.85 b	39.75 b	15.26 b	16.03 b
Calcium nitrate 1%	11.37 a	12.08 a	74.15 b	75.08 c	46.92 a	48.37 a	18.91 a	19.51 a

Means not sharing the same letter(s) with in each column, significantly different at 0.05 level of probability.

Table 4 Effect of some plant growth regulators and calcium nitrate on fruit weight, length, diameter and fruit firmness of "Le Conte" pear trees during 2012 and 2013 seasons.

Treatments	Fruit weight (g)		Fruit length (cm)		Fruit diameter (cm)		Fruit firmness (lb/ in ³)	
	2012	2013	2012	2013	2012	2013	2012	2013
Control	140.65 f	141.72 g	8.26 e	8.29 f	5.32 e	5.41 f	13.47 d	13.85 d
NAA at 50 ppm	152.46 d	154.82 d	8.51 d	8.92 d	5.62 d	5.92 d	13.51 d	13.92 d
NAA at 100 ppm	168.63 c	170.25 c	9.12 c	9.37 c	6.12 c	6.27 c	13.55 d	13.96 d

GA ₃ at 50 ppm	174.25 b	178.67 b	9.56 b	9.87 b	6.41 b	6.87 b	15.56 c	15.73 c
GA ₃ at 100 ppm	178.61 a	184.37 a	9.92 a	10.02 a	6.93 a	7.04 a	16.86 c	16.92 b
Calcium nitrate 0.5%	146.37 e	148.25 f	8.40 de	8.86 d	5.58 d	5.82 d	17.27 b	17.83 a
Calcium nitrate 1%	151.67 d	152.14 e	8.46 de	8.50 e	5.57 d	5.60 e	18.76 a	18.67 a

Means not sharing the same letter(s) with in each column, significantly different at 0.05 level of probability.

Table 5 Effect of some plant growth regulators and calcium nitrate on some chemical fruit characteristics of "Le Conte" pear trees during 2012 and 2013 seasons.

Treatments	TSS (%)		Acidity (%)		TSS/ acid ratio		Vitamin C (mg/ 100 ml juice)		Total sugar (%)	
	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
Control	11.60a	11.50 a	0.46 d	0.47 c	25.22 a	24.47 a	20.37 c	21.45 c	7.51 a	7.62 a
NAA at 50 ppm	11.50a	11.60 a	0.48 cd	0.49 c	23.96ab	24.29 a	20.84 c	21.76 c	7.48 a	7.61 a
NAA at 100 ppm	11.70a	11.80 a	0.47 cd	0.48 c	24.89 a	24.58 a	21.65 c	22.48 c	7.52 a	7.60 a
GA ₃ at 50 ppm	11.60a	11.70 a	0.50 bc	0.51 bc	23.20ab	22.94ab	24.86 b	25.21 b	7.42 a	7.58 a
GA ₃ at 100 ppm	11.50a	11.60 a	0.53 b	0.54 ab	21.70bc	21.48 b	27.46 b	28.36 a	7.40 a	7.57 a
Calcium nitrate 0.5 %	11.50a	11.60 a	0.56 a	0.55 ab	20.54 c	20.73 b	27.35 b	28.46 a	7.46 a	7.58 a
Calcium nitrate 1 %	11.60a	11.50 a	0.58 a	0.57 a	20.00 c	20.18 b	30.17 a	30.75 a	7.40 a	7.52 a

Means not sharing the same letter(s) with in each column, significantly different at 0.05 level of probability.

Table 6 Effect of some plant growth regulators and calcium nitrate on some leaf minerals of "Le Conte" pear trees during 2012 and 2013 seasons.

Treatments	Nitrogen (%)		Phosphours (%)		Potassium (%)		Calcium (%)		Magnesium (%)	
	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
Control	1.86 e	1.92 f	0.34 d	0.35 c	1.38 a	1.42 a	1.47 e	1.50 d	0.39 d	0.38 c
NAA at 50 ppm	1.92 d	1.98 e	0.38 bc	0.40 b	1.36 ab	1.38 bc	1.50 de	1.54 d	0.40 cd	0.39 c
NAA at 100 ppm	2.07 c	2.14 c	0.45 a	0.46 a	1.34 ab	1.35 bc	1.55 c	1.60 c	0.41bcd	0.40 c
GA ₃ at 50 ppm	2.22 b	2.37 b	0.37 c	0.39 b	1.37 a	1.40 ab	1.48 e	1.51 d	0.43 bc	0.42 bc
GA ₃ at 100 ppm	2.42 a	2.54 a	0.44 a	0.45 a	1.36 ab	1.37 bc	1.52 cd	1.53 d	0.46 ab	0.45 ab
Calcium nitrate 0.5 %	1.94 d	2.01 e	0.37 c	0.38 b	1.35 ab	1.39 ab	1.67 b	1.73 b	0.48 a	0.46 ab
Calcium nitrate 1 %	2.03 c	2.07 d	0.40 b	0.41 b	1.32 b	1.35 c	1.80 a	1.91 a	0.49 a	0.48 a

Means not sharing the same letter(s) with in each column, significantly different at 0.05 level of probability.