

Effect of Some Dormancy Breaking Agents on Flowering and Fruiting of Le-Conte Pear Trees under Giza Conditions

Safaa M. Maged, Hamed M. Mokhtar and Hanaa M. Sherif

Horticulture Research Institute, Agriculture Research Center, Giza, Egypt

Abstract: To study the effect of some dormancy breaking agents, Le-Conte pear trees grown under clay soil conditions were treated with Hydrogen Cyanamide (H_2CN_2) 3%+ Mineral oil 3%, Nature Garlic Extract 4%, Salicylic acid 200 ppm, Hydrogen peroxide (H_2O_2) 5%, Hydrogen peroxide (H_2O_2) 5% + mineral oil 3% and control (tap water) during two successive seasons (2016/2017-2017/2018). Bud development stages, chilling units, fruit set%, yield, fruit quality and net profit were studied. Data showed that, all treatments resulted in early bud break than control trees. The highest flowering% and fruit set% were obtained from Hydrogen peroxide (H_2O_2) 5% combined with mineral oil 3% treatment followed by Hydrogen Cyanamide (H_2CN_2) 3% + mineral oil 3% while the lowest percentage was obtained from control trees. All treatments increased yield more than untreated ones. It noticed that Hydrogen peroxide (H_2O_2) 5% combined with 3% mineral oil treatment had apposite effect on yield and fruit quality than the other treatments. Results also indicated that the highest content of carbohydrates, C/N ratio and the highest levels of IAA and GA_3 were obtained from the same treatment compared to the other treatments. Herein, Hydrogen peroxide (H_2O_2) 5% combined with mineral oil 3% is a promising treatment as a dormancy break agent to improve growth and fruit characteristics of Le-Conte pear trees.

Key words: Le-Conte pear trees • Breaking agents • Hydrogen Cyanamide (Dormex) • Hydrogen peroxide (H_2O_2) • Nature Garlic extract • Salicylic acid • Mineral oil • Flowering • Yield • Fruit quality

INTRODUCTION

In Egypt the most important pear cultivar is “Le-Conte” and its cultivated area decreased during the last years due to many problems, such as fire blight infection and insufficient chilling requirements [1, 2]. Japanese pear trees cultivars which grown in worm winter and have an irregular budding and flowering, demonstrating that they are not well adapted to climatic conditions, so it needs to treat with some of break dormancy agents to complete chilling requirements to improve flowering and yield [3]. Using natural products in horticultural practices instead of synthetic chemicals is the main purpose for producers of fruits [4]. There are many compounds used as dormancy breaking agents such as Hydrogen Cyanamide (H_2CN_2) trade name Dormex, Hydrogen peroxide (H_2O_2), Nature Garlic Extract, Salicylic acid (SA), mineral oil, etc. [5].

Many investigators reported that chilling requirement is essential for most of the plants that fall dormant in the winter in order to break their dormancy. In some areas

with low chilling duration, such as tropical locations, production is only possible under certain conditions by using effective cultural applications, such as using low chill cultivars, dormancy avoidance and using dormancy break agents [6-9]. Also, the effective temperatures to accumulate chilling requirements have been reported to range from 0°C to 7°C [10]. Temperatures lower than 0°C or higher than 7°C are not effective in this respect. Herein, the use of chemicals that promote budding and flowering is common practice in viability of the crop [11].

Hydrogen cyanamide (H_2CN_2) is used to reduce the breakage of endodormancy in pear and other deciduous fruit crops [12]. Buds treated with H_2CN_2 produce oxidative stress and transient respiratory disturbances which are related to the breakage. So, it's mechanism can be noticed in break dormancy by increasing respiration, accelerates vegetative and flower and that enhancing early and more uniform bud break [13-15]. By the way plants which respond to hydrogen cyanamide application depended on time of application and physiological stage of bud development and amount of chilling accumulated.

In addition, the application of 5% of Nature Garlic Extract increased by 4% of mineral oil, had similar effect to application of 0.52% Hydrogen Cyanamide with 4% mineral oil [16]. In Japan, studies on the effect of volatile and non-volatile compounds present species of the genus *Allium* has efficiency of garlic in overcoming dormancy grapevine buds [17]. Aline *et al.* [18] found that applications of garlic oil 20% promoted bud break. Also, the efficiency of the garlic extracts in break dormancy of apple buds cv. Fuji Kiku (garlic extract between 1 and 10% + 2% mineral oil) reached to 95%, in addition, flowering and maturation of fruits and yielding were similar to the results with mineral oil and hydrogenated Cyanamide treatment [19]. The garlic extract stimulated the sprouting of 70% of the buds of 'Cabernet Sauvignon' vine shoots, which received more than 168 h of cold below 6°C [20].

Hydrogen peroxide (H_2O_2) is described as being "water but with one more oxygen atom". In plants, H_2O_2 plays an important role by product of normal cell metabolism and as a regulatory molecule in stress perception and signal transduction [21, 22]. Herein plants tight regulation of the steady-state levels of H_2O_2 is necessary to avoid cellular injury and to maintain a base level of H_2O_2 on which different environmental and developmental signals can be registered. H_2O_2 content was increased and came at peak in late dormancy, when endodormancy was broken [23]. Haruyuki *et al.* [24] indicate that H_2O_2 is an effective compound for breaking endodormancy in flower buds of the Japanese pear.

Moreover, Salicylic acid (SA) is a hormone related to phenols which plays a critical role in the defense against biotrophic pathogens. it is a hormone-like substance that influences many physiological processes in plants such as seed germination, stomatal conductivity, transpiration, glycolysis, heat production, flowering and yield [25, 26]. It may be act as an endogenous signaling molecule in connection with flowering and thereby influences yield [27, 28]. However, spraying SA or its precursors (such as benzoic acid) have been shown to affect flower induction and flower numbers [29, 30]. Also, Salicylic acid was effective in improving yield and fruit quality of different fruit crops [31, 32].

Spraying mineral oils on low chilling cultivars as (Granny Smith) apple is more successful than on high chilling cultivars like (Golden Delicious) apple [33]. Also, it was found that, the most effective time for oil application was when the flower buds entered the deep dormancy and applying oil before opening of the first leaves delayed bud break. The aim of this study was to

explain the effect of Hydrogen Cyanamide (H_2CN_2), Nature Garlic Extract (NGE), Hydrogen peroxide (H_2O_2), Salicylic acid (SA) and mineral oil on flowering buds%, fruit set%, yield and fruit characteristics of "Le-Conte". Also, the possibility of replacing Hydrogen Cyanamide partially by other materials to reduce cost, increase flowering, fruit set and improve yield quantitatively & qualitatively.

MATERIALS AND METHODS

The present study was carried out during (2016/ 2017 - 2017/ 2018) to study the effect of some dormancy breaking agents on (Le-Conte) pear trees budded on *Pyrus Calleryana* rootstock grown in the experimental farm of Horticultural Research Institute, Agricultural Research Center, Giza, Egypt. Trees were 12 years old planted at 3.5 x 4 m. in a clay- silty soil under flood irrigation system. Trees under study were sprayed in 21 January in the first season and 4th February in the second season by the following applications:

- Hydrogen Cyanamide H_2CN_2 (Dormex* 50%) 3% combined with mineral oil 3% (Dormex* Trade Name. ALZ chem. Company. German).
- Nature Garlic Extracts (NGE) 4%.

Preparation of Garlic Extract: Garlic samples were grinded using a mortar and the active ingredients were extracted by ethyl alcohol (95%). The garlic mixture was filtered and the alcohol was removed by evaporating under vacuum (30°C) using rotary evaporator, Buchi model 011. The extract was kept cool in refrigerator (4°C) until use. Garlic extract was diluted by water to give the final concentration required.

- Salicylic acid (SA) 200 ppm.
Salicylic acid was dissolved in distilled water and the pH was adjusted at 6.5 with NaOH.
- Hydrogen peroxide (H_2O_2 - 50%) 5%.
- Hydrogen peroxide (H_2O_2 - 50%, 5% combined with mineral oil 3%.
- Control (Tap water only).

Three trees were labeled for each treatment. The experiment was arranged in a randomized complete block design. Furthermore, to evaluate the efficiency of the tested treatments on tree fruiting and fruit quality. Parameters were recorded through the study as follows:

Metrological Data: The climatological data of temperature were collected from Central Laboratory for Agricultural Climate-Agricultural Research Centre. Dates of both

beginning of flowering and beginning of fruit set including the periods of flowering and fruit set as well as date of harvesting at the end of the season were calculated. Chilling units from 1st November till date of bud break (end of endo dormancy stage) were recorded as follows:

- Number of hours at $\leq 7.2^{\circ}\text{C}$ [34] and chilling units at $\leq 7.2^{\circ}\text{C}$ were calculated = chilling hours $\leq 7.2^{\circ}\text{C} \times 1$ according to Fayek, *et al.* [35].
- Number of hours at $\leq 10^{\circ}\text{C}$ and chilling units at $\leq 10^{\circ}\text{C}$ were calculated = chilling hours $\leq 10^{\circ}\text{C} \times 0.7$ according to Fayek, *et al.* [35].

Index of Flower Bud Activity: Was recorded during flowering period (twice a week from 28 Feb. to 2 April). Flower bud development stages: 1- Dormant bud 2-Swelling bud 3- Green tip 4- Green cluster 5- Balloon stage 6- Full bloom 7- Fruit set.

Flowering Percentage: Four branches were selected and labeled and flowering percentage was calculated by the following equation.

$$\text{Flowering \%} = \frac{\text{No. of flowering buds}}{\text{Total No. of buds}} \times 100$$

Fruit Set Percentage: Was calculated as following:

$$\text{Fruit set \%} = \frac{\text{No. of developing fruits}}{\text{No. of total flowers}} \times 100$$

Yield: Weight of fruits per tree in Kg was calculated per each treatment.

Fruit Physical Characteristics: Sample of 10 mature fruits of each replicate were taken to determine physical characteristics (fruit weight “g”, fruit size “cm³”, fruit length and diameter “cm” and fruit firmness “lb/ inh²” were determined by Magness and Tayler pressure tester of 5-16-inch plunger according to İmrak [36].

Fruit Chemical Characteristics: Juice of fruit samples were used to determine total soluble solids (TSS%) by hand refractometer and fruit acidity according to A.O.A.C. [37].

Endogenous Hormones Levels: Endogenous hormones; IAA, GA₃ and ABA were determined in spurs (5 gm) at the end of January and February. Samples were frozen in a cold aqueous methanol 80% and were adjusted to 20 ml/

g. fresh weight and were stored at 2°C for 48 H. Hormones were extracted, fractionated and determined by using HPLC according to Wasfy and Orrin method [38].

Spurs Chemical Content: Spur chemical contents were determined in mid-August in both seasons. Total nitrogen was determined according to method of Evenhuis and Dewaard [39] and Evenhuis [40] and total carbohydrates were determined according to Smith *et al.* [41]. Carbohydrates / nitrogen ratio calculated as follows:

$$\text{C/N ratio} = \frac{\text{Total carbohydrates}}{\text{Total nitrogen}}$$

Net Profit (LE): Fruit yield and weight were used in estimating crop monetary value considered a farm-gate price of 7&6 LE/Kg for the first class and 6&5 LE/Kg for the second class in the first and the second season, respectively. As for percentage of treatments cost/ fed, control treatment cost %/ fed had considered equal zero.

Net profit LE/ fed for treatments were calculated as follows:

yield price (LE/fed) - treatments cost (LE/Fed).

Statistical Analysis: Data in this study were statistically analyzed according to the method of Snedecor and Cochran [42] in each season L.S.D at 5% level and Duncan multiple range test [43] were used for comparison between means of each treatment.

RESULTS AND DISCUSSION

Accumulated Chill Units: In this respect accumulated chill units were calculated according to Fayek [35] by calculating the chilling hours accumulated at ≤ 7.2 and 10°C (Table 1). Weather conditions influence flowering and fruiting in direct way by influencing on pollination, stigma receptivity and ovule fertility [44, 45].

Date of Bud Burst: Concerning the effect of Hydrogen Cyanamide H₂CN₂ (Dormex) 3%+mineral oil 3%, Nature Garlic Extract 4%, Salicylic acid (SA) 200 ppm, Hydrogen peroxide (H₂O₂) 5 % and Hydrogen peroxide (H₂O₂) 5% + mineral oil 3% on date of bud burst of "Le-Conte" pear trees during the two experimental seasons (2016/2017 and 2017/2018) are presented in Table (2). It was noticed that all treatments applied gave earlier bud burst compared to untreated trees. It appeared that H₂O₂ 5% combined with

Table 1: Accumulated Chill hours and Chill units during (2016/2017) and (2017/2018) in Giza conditions.

	Bud break date	Average of Chill hours $\leq 7.2^{\circ}\text{C}$	Average of Chill hours $\leq 10^{\circ}\text{C}$	Average of Chill units $\leq 7.2^{\circ}\text{C}$	Average of Chill units $\leq 10^{\circ}\text{C}$	Total chill units $\leq \text{c.u. at } \leq 7.2^{\circ}\text{C} + \text{c.u. at } \leq 10^{\circ}\text{C}$
1 st season	15/2	189.3	577.8	189.3	404.46	593.76
2 nd season	9/2	347.7	749.7	347.7	524.79	872.49

Table 2: Effect of some dormancy breaking agents on date of bud burst of "Le-Conte" pear trees in (2016/2017) and (2017/2018) seasons

Treatments	Date of bud burst 1 st season	Date of bud burst 2 nd season
Dormex 3% + Mineral Oil 3%	15/2/2016	13/2/2017
Garlic Extract 4	21/2/2016	19/2/2017
Salicylic acid 200 ppm	14/2/2016	12/2/2017
H ₂ O ₂ 5%	28/2/2016	23/2/2017
H ₂ O ₂ 5% + Mineral Oil 3%	15/2/2016	9/2/2017
Control	3/3/2016	28/2/2017

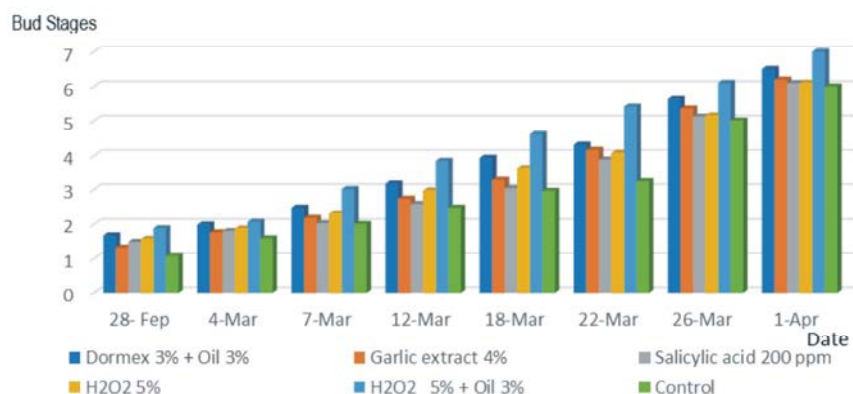


Fig. 1: Effect of some dormancy breaking agents on bud development stages of "Le-Conte" pear trees in (2016/2017) and (2017/2018).

3% mineral oil caused an earlier bud burst (15/2&9/2) in both seasons respectively followed by Dormex 3% with mineral oil 3% (15/2&13/2), while Nature Garlic Extract (NGE) 4% (21/2&19/2), salicylic acid 200 ppm (14/2&12/2) and H₂O₂ 5% (28/2&23/2) gave moderate effect in both seasons. Whereas untreated trees bud burst later than the treated trees. Some others stated that dormancy breaking agents reduced the chill units for deciduous trees such as Imark *et al.* [46] on apple and kundu *et al.* [47] on pear.

Bud Development Stages: Referring to the effect of dormancy breaking agents treatments (Hydrogen Cyanamide (Dormex) 3%+mineral oil 3%, Nature Garlic Extract (NGE) 4%, Salicylic acid (SA) 200 ppm, Hydrogen peroxide (H₂O₂) 5% and Hydrogen peroxide (H₂O₂ 5% + mineral oil 3%), it was quite evident as shown from Fig. 1 that Hydrogen peroxide (H₂O₂ & Oil and Hydrogen Cyanamide (H₂CN₂) & Oil accelerated bud burst flowering and reduced the flowering period (Fig. 1). Herein, it was noticed that dormancy breaking agents treatments improve bud development and flowering than untreated trees in both seasons under study.

Flowering (%): The results in Table (3) represented that all treatments applied gave a significantly flowering % compared to untreated trees. Data revealed that H₂O₂ 5% combined with mineral oil 3% (19.0&19.2%) followed by Dormex 3% with mineral oil 3%(18.2&18.6%) recoded highest percentage, while H₂O₂ 5% (17.5&17.9%), Nature Garlic Extracts 4%(16.1&16.5%) and salicylic acid 200 ppm (15.1&15.5%) gave moderate effect in both seasons under study(2016/2017&2017/2018) respectively. Our data in a harmony with those who reported that breaking dormancy treatments resulted in earlier flowering [48, 46].

Fruit Set (%): Percentage of fruit set was affected by dormancy breaking agents treatments during the two successive seasons of the study (2016/2017 and 2017/2018). Table (3) showed that, there was a significant increase in fruit set % as a result of Hydrogen Cyanamide (H₂CN₂) 3%+mineral oil 3%, Nature Garlic extract 4%, Salicylic acid 200 ppm, Hydrogen peroxide (H₂O₂) 5%, Hydrogen peroxide (H₂O₂) 5% + mineral oil 3%in the two studied seasons. All experiment treatments gave the highest percentage of fruit set in both seasons compared

Table 3: Effect of some dormancy breaking agents on flowering (%), fruit set (%) and yield (kg/tree) of "Le-Conte" pear trees in (2016/2017) and (2017/2018) seasons

Treatments	Flowering (%)		Fruit set (%)		Yield (Kg/Tree)	
	1 st season	2 nd season	1 st season	2 nd season	1 st season	2 nd season
Dormex 3% + Mineral oil 3%	18.2 ab	18.6 ab	9.29 b	10.2 b	41.91 b	43.33 b
Garlic Extract 4%	16.1 c	16.5 c	8.33 cd	9.1 c	37.16 cd	38.06 cd
Salicylic acid 200ppm	15.1 d	15.5 d	7.63 d	8.06 d	34.82 d	35.63 d
H ₂ O ₂ 5%	17.5 b	17.9 b	8.61 bc	9.73 bc	37.41 c	38.90 c
H ₂ O ₂ 5% + Mineral oil 3%	19.0 a	19.2 a	10.5 a	11.2 a	47.81 a	50.68 a
Control	11.4 e	11.6 e	3.81 e	4.04 e	29.78 e	30.68 e

Means within each column followed by the same letter(s) are not significantly different at 5%

Table 4: Effect of some dormancy breaking agents treatments on fruit physical properties of "Le-Conte" Pear trees during 2016/2017 and 2017/2018 seasons

Treatments	Fruit weight (gm)		Fruit size (cm ³)		Fruit length (cm)		Fruit diameter (cm)		Fruit firmness (Lb/ inch ²)	
	Season 1	Season 2	Season 1	Season 2	Season 1	Season 2	Season 1	Season 2	Season 1	Season 2
Dormex 3% + mineral oil 3%	185.36 a	192.86 a	187.03 a	193.58 a	7.36 b	8.80 b	8.03 a	9.50 ab	20.07 b	21.18 bc
Garlic Extract 4%	155.15 bc	162.91 bc	56.47 bc	163.37 bc	7.203 bc	8.46 bc	6.33 b	7.84 c	18.76 b	20.82 c
Salicylic acid 200 ppm	153.47 bc	161.07 bc	156.31bc	163.04 bc	6.54 cd	8.04 cd	6.83 b	8.49 b	18.84 b	20.35 c
H ₂ O ₂ 5%	160.54 b	167.97 c	162.51b	168.91 c	6.86 bcd	8.35 bc	6.88 b	8.35 c	19.39 b	21.26 bc
H ₂ O ₂ 5% + mineral oil 3%	190.99 a	198.76 a	192.18 a	198.85 a	8.38 a	9.68 a	8.71 a	9.97 a	19.84 b	22.16 ab
Control	147.14 c	154.96 c	149.55 c	156.14 c	6.19 d	7.51 d	6.49 b	7.97 c	22.46 a	22.85 a

Means within each column followed by the same letter(s) are not significantly different at 5%

with the control. Data presented in Table (3) showed that the most significant fruit set was obtained from H₂O₂ 5% combined with mineral oil 3% (10.5%&11.2%) followed by Dormex 3% with mineral oil 3% (9.29% & 10.2%) followed by NGE (8.33% & 9.1%), H₂O₂ 5% (8.61%&9.73%) and Salicylic acid 200 ppm (7.63%&8.06%) in both seasons receptively. In the other hand, control trees gave the lowest fruit set per tree in both seasons (3.81%&4.04%). It is obvious that fruit set% reflects the increasing in flowering percentage. Our data are in line with Imark [36] and Fahmy *et al.* [48], Gomes *et al.* [49] and Wang *et al.* [50] on pear who reported that breaking agent dormancy increase the fruit set due to the flowering early and regular than the untreated trees.

Yield (Kg/ Tree): It was obvious from Table (3) that yield per tree (Kg) was affected by dormancy breaking agents treatments and it increased the fruit yield (Kg/tree) in all treatments and both seasons under study compared with untreated trees. Moreover, the yield went in the same trend with fruit set percentage. Regarding yield/tree as (kg) it can be noticed that trees treated with H₂O₂ 5% combined with mineral oil 3% gave (47.81&50.68Kg) and Dormex 3% with mineral oil 3%(41.91&43.33Kg) reflected the highest significant yield during the two seasons under study. Also, it noticed that Nature Garlic Extract 4% (37.16&38.06Kg) and H₂O₂ 5% (37.41&38.90 Kg) had significant result followed by Salicylic acid 200 ppm

(34.82&35.63Kg) compared to untreated trees which was the lowest yield (29.78&30.68Kg) in both seasons 2017& 2018. Differences were found between yields was due to differences in flowering dates and fruit set %. The present results are in harmony with Fahmy *et al.* [48], Gomes *et al.* [49] and wang *et al.* [50] on Le-Conte pear, Kabsha [51] on Florida prince who stated that using dormancy breaking agents increased yield.

Fruit Physical Properties

Fruit Weight (G): Data obtained during the both experimental seasons (2016/2017&2017/2018) and presented in Table (4) cleared that, all treatments under study resulted in a significant fruit characteristic as compared to control in both seasons. The significant values for fruit weight were obtained from the two treatments H₂O₂ 5% combined with mineral oil 3% (190.99&198.76 gm) and Dormex 3% with mineral oil 3% (185.36&192.86 gm) in both seasons. On the other hand, the lowest fruit weight was obtained from untreated treatment (147.14&154.96 gm). Among treatments there were no significant variations in fruit weight between Garlic Extract 4% treatment and Salicylic acid 200 ppm in both seasons.

Fruit Size (cm³): Regarding fruit size (cm³), data in Table (4) revealed that fruit size had the same trend showed in fruit weight. Furthermore, data indicated that all treatments under study resulted in bigger fruit size

Table 5: Effect of some dormancy breaking agents on fruit chemical properties of "Le-Conte" Pear trees during 2016/2017 and 2017/2018

Treatments	TSS%		Acidity		TSS/ Acidity	
	1 st Season	2 nd Season	1 st Season	2 nd Season	1 st Season	2 nd Season
Dormex 3% + mineral oil 3%	12.36 b	12.66 b	0.16 b	0.19 c	77.25b	66.63b
Garlic Extract 4%	12.18 b	12.72 b	0.25 a	0.27 b	48.72b	47.11b
Salicylic acid 200 ppm	12.32 b	13.00 ab	0.27 a	0.28 ab	45.62b	46.42b
H ₂ O ₂ 5%	12.34 b	12.71 b	0.16 b	0.18 c	77.12b	70.61b
H ₂ O ₂ 5%+ mineral oil 3%	13.28 a	13.55 a	0.16 b	0.17 c	83.00a	79.70a
Control	11.17 c	11.70 c	0.30 a	0.33 a	37.23c	35.45c

Means within each column followed by the same letter(s) are not significantly different at 5% level.

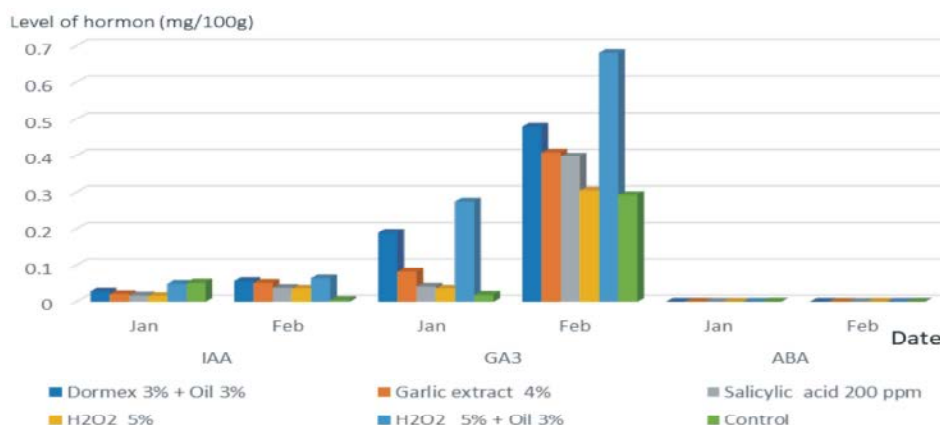


Fig. 2: Effect of some dormancy breaking agents on IAA, GA3 and ABA (mg/100g) content of "Le-Conte" pear trees in (2016/2017) and (2017/2018) seasons.

compared to control. The highest fruit size values obtained from H₂O₂ 5% combined with mineral oil 3% (192.18&198.85 cm³) and Dormex 3% with mineral oil 3% (187.03 & 193.58 cm³) in both seasons respectively. Meanwhile, the lowest fruit size was obtained from control treatment in both seasons (149.55&156.14 cm³).

Fruit Dimension: Table (4) indicated that all treatments under study significantly increased fruit length and diameter compared to control. The highest fruit length and diameter were obtained from H₂O₂ 5% combined with mineral oil 3% followed by Dormex 3% with mineral oil 3%, NGE 4%, H₂O₂ 5% and Salicylic acid 200 ppm in the 1st and the 2nd season under study. On the other hand, the lowest fruit length and diameter was obtained from the control trees.

Fruit Firmness: Regarding fruit firmness Table (4) demonstrated that all treatments reduce fruit firmness in both seasons compared to control.

So, it can be noticed that all treatments improved fruit physical properties compared by untreated ones due to earlier flowering and fruiting. In this respect, Fahmy *et al.* [48] on pear, Mohamed and Sherif [52] on peach and El-Sabagh *et al.* [13] on apple mentioned

that all fruit physical parameters were positively affected by breaking dormancy agent treatments than untreated trees.

Chemical Fruit Properties: Chemical properties of fruits are demonstrated in Table (5). It is obvious that all treatments increased TSS and decreased acidity compared to the control. Higher values of total soluble solids, TSS/acidity ratio and lower acid content were obtained from H₂O₂ 5% + 3% Oil followed by Dormex 3%+ Oil 3%, Nature Garlic Extract 4%, Salicylic acid 200 ppm and H₂O₂ 5% treatment in both seasons compared with control treatment. These results are supported by those obtained by Fahmy *et al.* [48], Kabsha [51], Mohamed and Sherif [52] and El-Sabagh [13].

Endogenous Hormones Levels: The effect of Hydrogen Cyanamide (Dormex) 3% + mineral oil 3%, Nature Garlic Extract 4%, Salicylic acid (SA) 200 ppm, Hydrogen peroxide (H₂O₂) 5% and Hydrogen peroxide (H₂O₂) 5% + mineral oil 3% on endogenous hormones on "Le-Conte" pear trees were studied during the two experimental seasons (2016/2017 and 2017/2018). Data presented in Fig. (2) showed significant differences in Endogenous hormones levels (IAA, GA3 and ABA) in response to

Table 6: Effect of some dormancy breaking agents on C (%), N (mg/100 g) and C/N ratio of "Le-Conte" pear trees in (2016/2017) and (2017/2018) seasons.

Treatments	C (%)		N (mg/100 g)		C/N ratio	
	1 st Season	2 nd Season	1 st Season	2 nd Season	1 st Season	2 nd Season
Dormex 3% + Mineral oil 3%	9.34 b	9.09 b	0.87 b	0.95 b	10.74 b	9.57 b
Garlic Extract 4%	7.31 c	7.77 c	1.70 c	1.75 b	4.30 c	4.44 c
Salicylic acid 200ppm	7.43 c	7.88 c	1.91 b	2.61 b	3.89 c	3.02 c
H ₂ O ₂ 5%	7.29 c	7.90 bc	0.86 d	0.91 cd	9.59b	8.68 b
H ₂ O ₂ 5% + Mineral oil 3%	10.34 a	10.85 a	0.69 e	0.72 d	14.99a	15.07 a
Control	4.86 d	5.22 d	2.12 a	2.36 a	2.29 d	2.06 d

Means within each column followed by the same letter(s) are not significantly different at 5%

Table 7: Effect of some dormancy breaking agents on the net profit (LE) of "Le-Conte" Pear trees during 2016/2017 and 2017/2018 seasons.

Treatments	Productivity (Ton/fed.)		Increasing of production (Ton/fed.)		Treatments cost (LE /fed)		Cost (%) / fed		Yield price (LE /fed)		Net profit (LE/ fed)	
	1 st Season	1 st Season	1 st Season	2 nd Season	1 st Season	2 nd Season	1 st Season	2 nd Season	1 st Season	2 nd Season	1 st Season	2 nd Season
Dormex 3% + Mineral oil 3%	12573	12999	3639	3795	3240	3240	14.84	12.20	75438	90993	72198	87753
Garlic Extract 4%	11148	11418	2214	2214	300	300	2.710	2.260	55740	68508	55440	68208
Salicylic acid 200ppm	10446	10689	1512	1485	200	200	2.650	2.245	52230	64134	52030	63934
H ₂ O ₂ 5%	11223	11670	2289	2466	4800	4800	41.93	32.44	56115	70020	51315	65220
H ₂ O ₂ 5% + Mineral oil 3%	14343	15204	5409	6000	5700	5700	17.56	13.57	86058	106428	80358	100728
Control	8934	9204	0.0	0.0	0.0	0.0	0.0	0.0	44685	55224	0.0	0.0

dormancy breaking agents in both seasons under study. IAA and GA₃ gave the highest values in H₂O₂ 5% combined with 3% Mineral oil followed by Dormex 3% combined with 3% Mineral oil followed by NGE 4%, H₂O₂ 5% and salicylic acid 200 ppm. Also, the lowest result was recorded in untreated trees. Whereas, ABA vice versa IAA and GA₃ in all treatments in both dates (Jan. & Feb.) under study.

Mineral Spurs Content: Dormancy breaking agents treatments had changed the natural carbohydrate concentration and increased the sugar content and promoted a more uniform carbohydrate distribution along the shoots. Table (6) cleared the effect of Hydrogen Cyanamide (Dormex) 3% + mineral oil 3%, Nature Garlic Extract 4%, Salicylic acid (SA) 200 ppm, Hydrogen peroxide (H₂O₂) 5% and Hydrogen peroxide (H₂O₂)5% + mineral oil 3% on "Le-Conte" pear trees during the two experimental seasons (2016/2017 and 2017/2018). Data represent in Table (6) showed that all dormancy breaking agents increased carbohydrates and vice versa the untreated trees in both seasons under study, respectively. Hydrogen peroxide (H₂O₂) 5%+ Mineral oil 3% gave a higher carbohydrate content significantly and lowest nitrogen followed by Hydrogen Cyanamide (Dormex) 3% + Mineral oil 3%, Nature Garlic Extract 4%, Salicylic acid (SA) 200 ppm and Hydrogen peroxide (H₂O₂) 5% compared with untreated trees. Herein C/N ratio has the same line with carbohydrate in both season under study.

In this respect, Rehman *et al.* [53] and Pandey *et al.* [54] noticed that H₂O₂ increased carbohydrates content

and increased C/N ratio of the cell which broke dormancy in Asian pear and resulted in increasing spur maturity. Furthermore, Jana and Bikash [55] declared that, H₂CN₂ (Dormex) minimizes dormancy period of Asian pear by calcium dependent protein phosphorylation in bud cells. In addition, endodormancy progression can be changed by carbohydrate metabolism, possibly for supporting the carbohydrate demands in buds for growth resumption after breaking endodormancy. Carbohydrate reserves in plants undertake seasonal variations; they collect late in perennial structure during the growth period and are utilized later during bud growth recommencement [56]. Herein, it seems likely that carbohydrate reserves are the key energy source that arises during dormant period for the metabolic changes and spring bud break.

Crop Monetary Value (LE/Fed.): Table (7) illustrated the effect of some dormancy breaking agents on the net profit (LE/fed) for treatments during the two seasons of study (2016/2017 & 2017/2018). The highest net profit was obtained from Hydrogen peroxide (H₂O₂) 5%+ Mineral oil 3% treatment (80358 and 100728 LE/fed) during the two seasons respectively compared to other treatments and that due to its high productivity and fruit quality.

CONCLUSION

In this study, we aim to explain if the other chemical compounds could be used as alternatives to Hydrogen Cyanamide without any decreases in fruit yield and quality. As a conclusion, the results obtained in this

study cleared that Hydrogen Cyanamide (H_2CN_2) was used as the dormancy breaking agent many years ago and still being used. Several alternative commercial dormancy breaking chemicals have been tested until today, H_2O_2 5% and mineral oil 3% was found to be the best dormancy breaking agent followed by Hydrogen Cyanamide and Garlic Extract. H_2O_2 and mineral oil especially advanced earlier bud break and increased flowering, fruit set, yield and fruit quality. This is an indicator for the growers to use H_2O_2 5% and 3% mineral oil in commercial scale.

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