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EFFECT OF WINTER OIL AND DORMEX SPRAYS ON FRUIT QUALITY AND STORAGE ABILITY OF LECONTE PEAR FRUITS

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ABSTRACT

This investigation was carried out during 2005 and 2006 seasons to study the effect of spraying Leconte pear trees with winter oil at 2 % and Dormex at 1, 2 % each alone or in combination as Dormancy breaking agents to study their effect on fruit quality at harvest time and storage ability through marketing for 6 days under room temperature. The data revealed that dormex at 1 or 2 % each alone or with winter oil significantly increased fruit weight, firmness and SSC/acid ratio at harvest than spraying with winter oil or the control. Furthermore, winter oil alone or with dormex significantly reduced the percent of total loss in fruit weight than those sprayed with dormex alone or the control.

Fruit firmness was reduced but total caroteniods and SSC/acid ratio were increased through marketing after 6 days from harvest. In this respect, sprayed Le-Conte pear with both winter oil and Dormex at 2 % gave a more pronounced effect on fruit quality at harvest time and through marketing.

INTRODUCTION

Pears (*Pyrus communis*, L.) are considered the third importance one among the other deciduous fruits in the world and fourth among all fruits for which statistics are available (Childers, 1994). At the last years the cultivated area of pear are reduced in Egypt since it reached about 8362 feddans with total production about 38192 metric tons according to the statistics of the Ministry of Agriculture, 2005.

The major obstacle to economic production of deciduous fruit trees in subtropics and tropics is the insufficient period of chilling hours. Since, the mild winter of Egypt usually prolongs rest of Leconte pears is the main cultivar grown under Egyptian conditions. Inadequate chilling requirements of this cultivar leads to reducing flower buds opening, and prolong blooming periods.

Application of chemicals has been necessary to achieve bud break and better cropping in such areas of the world (Diaz *et al*., 1987). Hydrogen cyanamide has been identified as one of the most effective dormancy breaking agents in many deciduous plant species (Fuchigami & Nee, 1987). Also, hydrogen cyanamide on Nashi (*Pyrus serotina*, Rohd) advanced the onest of flowering, shortened the flowering period and increased fruit production with no adverse effect on fruit weight and quality, but differences occurred due to date of application (Klinak *et al*., 1991). Moreover, hydrogen cyanamide application increased the floral bud activity and advanced bud burst and full bloom in three Asian pear cultivars. Fruit total soluble solids was increased while, juice acidity and fresh firmness were reduced in some cases (Mokhtar *et al*., 1994). Furthermore, Dormex at 4 % concentration gave better results than 2 % in advancing bud break, enhancing bud burst and increasing fruit set of "Leconte" pear (Stino, 1987).

Several growth regulators and chemicals have been tried for their effectiveness in substituting for chilling of dormant organs. DNOC (Universal oil) was the first chemical used for breaking rest in some deciduous fruit trees. Furthermore, winter oil (DNOC) have been used commercially with success on apples and pears to ensure a greater uniformity in bud break and to alleviate problems associated with delayed foliation (Erez & Zur, 1981 and Saeid *et al*., 1992). Furthermore, Hydrogen cynamide (Dormex) at a low concentration (0.5 % to 1 %) in combination with winter oil at 3 to 4 % is now recommended commercially on apples (Costa *et al*., 2004).

In this study the effect of spraying Leconte pear with some breaking agents such as winter oil or Dormex alone or in combination on fruit quality at harvest time and their effect on storage ability through marketing at room temperature were evaluated.

MATERIALS AND METHODS

The present study was carried out during the two seasons of 2005 and 2006 on "Leconte" pear trees to evaluate the effect of spraying dormex and winter oil each alone or in combination as a post-harvest treatment on fruit quality at harvest time and its behavior through marketing after 6 days from harvest at room temperature conditions.

Leconte pear trees were about ten years old grown in clay loam soil spaced at 4 meters between trees and 5 meters between rows under drip irrigation system at private orchard near El-Khatatba city, Monifia Governorate, Egypt.

For this study 36 trees were selected at random, 2 trees per each treatment replicated 3 times, 6 trees received one of the following treatments:

1- Control.
2- Winter oil at 2 %.
3- Dormex at 1 %.
4- Dormex at 2 %.
5- Winter oil at 2 % + Dormex at 1 %.
6- Winter oil at 2 % + Dormex at 2 %.

Both winter oil and dormex were applied at the end of January for the two seasons of the study. Leconte pear fruits were harvested at 135 to 147 days from full bloom, when average fruit firmness reached about 13–14 $lb/inch^2$ and when soluble solids in fruits juice reached about 12–15 % according to Swindman, (2002).

Samples of about 20 fruits from each replicate were taken at harvest time and transported to the laboratory of Pomology Dept., Mansoura Univ. to determine the effect of spraying dormex and winter oil on fruit characteristics at harvest time.

For storage studies about 10 kg of fruits from each treatment were taken and bags packed using ventilated plastic bags. All fruit bags were weighed and every six bags were put in ventilated carton box, from each treatment (two bags per each replicate). Carton boxes were held at room temperature at 30 ± 1 ^{0}C and 75 – 80 % relative humidity (R.H) for six days to study the effect of winter oil and dormex on total loss in weight and changes in fruits quality during marketing under room temperature.

Total loss in weight :

$$\text{A- Weight loss \%} = \frac{\text{Initial weight – Weight at sampling date}}{\text{Initial fruit weight}} \times 100$$

$$\text{B- Decay \%} = \frac{\text{Weight of decayed fruits}}{\text{Initial fruit weight}} \times 100$$

C- Total loss in fruit weight percentage :

Total loss % = loss in fruit weight % + decayed fruits %

Fruit firmness : it was measured on 15 fruits for each treatment (5 fruits for each replicate) using a hand Effgi-penetrometers supplemented with a plunger 8 mm diameter and the average was estimated as Ib/inch^2 according to (Harker *et al*., 1996).

Soluble solids content : it was measured by using a hand refractometer according to (Chen & Mellenthin, 1981).

Total titratable acidity : it was expressed as g Malic acid/100 ml juice according to (A.O.A.C., 1980) and Soluble solids content (SSC)/acid ratio was estimated.

Total caroteniods content :

Weight of 0.5 gm of fresh skin fruits was ground by 10 ml methanol for 24 hr. then total caroteniod was determined by spectrophotometer at the wave length 452.5 nm and estimated as mg/100 gm fruit weight according to Mackinny, (1941).

Statistical analysis :

Data of both seasons of the study were statistically analyzed using complete randomized block design as described by Snedecor & Cochran, (1980). Differences among treatment means were compared by using the least significant differences test (LSD) at 5 % level of probability.

RESULTS AND DISCUSSION

These results presented the effect of winter oil and dormex each alone or in combination on fruit quality of Leconte pear fruits of harvest time and changes of fruit characteristics after harvest at room temperature condition.

I. Effect of winter oil and dormex on fruit quality of Leconte pear at harvest time.

Fruit weight :

Data from Table (1) presented that spraying Leconte pear trees with dormex at 1 or 2 % each alone or with winter oil at 2% at the end of January significantly increased average fruit weight than treated with winter oil only or the control. Whereas, dormex at 1 or 2 % alone gave no significant effect than obtained from winter oil application. Yet, winter oil at 2 % gave a

somewhat increment in average fruit weight than the control, but the difference between these treatments were non significant during both seasons of the study. In this respect, it is clear that dormex was more effective for increasing average fruit weight than winter oil.

From this study dormex application at 1 or 2 % each alone or with winter oil at 2 % significantly increased average fruit weight than winter oil or control. The increment in fruit weight may be due to their effect on enhancing bud burst and fruit maturity. Similarly, Mann *et al*., (1992) presented that dormex at 2, 3 and 4 % enhanced bud burst by 2 weeks, flowering by 10 days and fruit maturity of 7 days. Also, Fallahi & Fallahi (2004), mentioned that dormex increased fruit weight of apple. Also, Son & Kuden (2005) reported that 1 % and 2 % of hydrogen cyanamide gave better flower, vegetative bud break and increased fruit weight in Plum and Apricot fruits.

Table (1) : Effect of winter oil and dormex on fruit weight, firmness and total caroteniods at harvest time.

Treatments	Fruit weight (g)		Firmness (g/inch^2)		Carotenoides (ml/100 g F.W.)	
	2005	2006	2005	2006	2005	2006
Control	186.1	187.3	13.2	13.5	0.652	0.741
Winter oil 2 %	195.0	194.2	14.2	13.8	0.691	0.732
Dormex 1 %	209.8	204.0	14.5	14.1	0.623	0.742
Dormex 2 %	216.0	207.7	14.8	14.6	0.641	0.752
Oil + Dormex 1%	208.5	205.0	15.6	14.1	0.633	0.753
Oil + Dormex 2%	207.2	203.7	14.7	14.1	0.581	0.712
L.S.D at 5 %	10.94	8.19	0.517	0.791	0.068	0.046

Fruit firmness :

It is clear from Table (1) that dormex at 1 or 2 % alone or with winter oil at 2 % significantly increased fruit firmness than the control. Furthermore, dormex application at 1 or 2 % with 2 % oil gave higher fruit firmness than the other treatments or the control. Yet, trees sprayed with winter oil at 2 % alone gave a lower fruit firmness than the other treatments, but higher than the control. Similarly, Fallahi & Fallahi (2004), presented that winter oil or dormex treatments increased both fruit firmness and SSC/acid ratio than the control. Also, Bound & Jones (2004) reported that dormex at 1 and 2 % significantly increased flesh firmness of apple fruits compared with the control.

Total caroteniods :

With regard to the effect of dormex and winter oil each alone or in combination on total caroteniods in fruit skin of pear fruits, data from Table (1) presented that these materials gave no clear effect in this respect. Yet, Leconte pear trees sprayed with winter oil at 2 % gave higher significant values of total caroteniods in fruit skin than the other treatments or the control. Whereas, dormex application with winter oil at 2 % gave lower significant values of total caroteniods than the control.

Soluble solids content :

Data from Table (2) showed that SSC in juice of Leconte pear fruit was affected by dormex or winter oil applications. In this respect, the data reveal that spraying pear trees with dormex at 1 or 2 % with oil at 2% gave highly significant SSC than the other treatments or the control. Yet, dormex or winter oil each alone gave a somewhat increment of SSC in fruit juice than the control, but the differences between these treatment and the control were unpronounced. Whereas, Bound & Jones (2004) reported that dormex at 1 % significantly increased SSC % in Fuji apple fruits.

Table (2): Effect of winter oil and dormex on percent of SSC, total acidity and SSC/acid ratio at harvest time.

Treatments	SSC %		Total acidity %		SSC/acid ratio	
	2005	2006	2005	2006	2005	2006
Control	10.1	10.4	0.265	0.276	38.1	37.7
Winter oil 2 %	10.6	10.6	0.272	0.278	39.0	38.1
Dormex 1 %	10.5	10.3	0.263	0.257	39.9	40.1
Dormex 2 %	10.7	10.8	0.270	0.268	39.6	40.3
Oil + Dormex 1%	11.8	11.7	0.278	0.273	42.5	42.9
Oil + Dormex 2%	11.7	11.6	0.283	0.287	41.3	40.4
L.S.D at 5 %	**0.522**	**0.366**	**0.018**	**0.016**	**3.35**	**2.99**

Total acidity :

It is obvious from Table (2) that dormex application at 1% gave a lower significant value of total acidity than the other treatments or the control as a mean of the two seasons. Whereas dormex application with winter oil at 2% gave a higher total acidity in fruit juice. Generally, these treatments presented unpronounced effect between the other treatments used. These results go in line with those reported by & and Kuden (2005), they stated that spraying Apricot and Plum trees with dormex at 1 and 2 % gave no clear effect on total acidity.

SSC/acid ratio :

Data from Table (2) showed that dormex or winter oil application each alone or in combination increased the percent of SSC acid ratio in fruit juice than the control. Furthermore, dormex at 1% with winter oil at 2% gave highly significant values than the other treatments or the control. The increments due to these treatments may be due to their effect on increasing the values of SSC in fruit juice. Yet, oil application gave lower values than the other treatments but almost higher than the control. That is not astonishing since these treatments produced lower SSC with higher total acidity in fruit juice.

The increment attributed to SSC / acid ratio for these treatments may be due to that dormex advanced fruit maturity, and the soluble solids content was increased. In this respect, El-Gharib *et al*., (1995) presented that winter oil (Universal oil) gave a higher fruit firmness than the control. Moreover, Bepete & Jakson (1995) showed that Dormex at 2 % and 3 % increased percentage of soluble solids content in fruit juice of Le-Conte pear.

II. Effect of winter oil and dormex on total loss and changes in fruit characteristics of Leconte pear at room condition.

A- Effect on total loss in fruit weight :

Weight loss percent :

Data from Table (3) showed that the losses in fruit weight on pear fruits during storage were significantly increased as storage period advanced from harvest till 6 days under room condition. With regard to the effect of dormex or oil application, data reveal that dormex or oil application each alone or together significantly reduced the total loss in fruit weight than the control. Whereas, winter oil at 2 % each alone or with dormex at 2 % reduced the loss in fruit weight significantly than the other treatments or the control. Thus, winter oil at 2 % almost reduced the percent of loss in weight that dormex at 1 or 2% during the two season of study.

Table (3): Effect of winter oil and dormex on weight loss, decay and total loss after 6 days from harvest under room temperature.

Treatments	Weight Loss %		Decay %		Total loss %	
	2005	2006	2005	2006	2005	2006
Control	2.13	2.82	4.34	5.86	6.47	8.50
Winter oil 2 %	1.80	1.95	3.69	3.86	5.49	5.81
Dormex 1 %	1.97	2.01	3.81	4.38	5.78	6.39
Dormex 2 %	2.10	2.25	3.48	3.87	5.56	6.12
Oil + Dormex 1 %	1.73	2.14	3.39	3.94	5.12	6.08
Oil + Dormex 2 %	1.68	1.97	3.36	3.77	5.04	5.74
L.S.D at 5 %	**0.066**	**0.078**	**0.316**	**0.482**	**0.336**	**0.513**

Decay percent :

Data from Table (3) showed that the percent of decayed fruits was significantly increased as storage period advanced under room temperature. The data also presented that dormex or winter oil treatments each alone or in combination reduced the percent of decayed fruits through marketing from harvest under room condition. Whereas, trees sprayed with winter oil and dormex at 2% reduced the percent of decayed fruits than the other treatments. Since, the percent of decayed fruits due to these treatments was about 3.6% but it reached about 5.1% for the control after 6 days under room temperature as a mean of the two seasons.

Total loss percent :

Total loss in fruit weight due to loss in fruit weight and decay percentage are presented in Table (3). So, the total loss was increased significantly as storage period advanced from harvest till 6 days held under room condition. The data also showed that all treatments used significantly reduced the total loss in fruit weight than the control. Furthermore, winter oil each alone or with dormex at 2 % significantly reduced the percent of total loss than the other treatments. Since, the percent of total loss for this treatment was 5.4 % but it reached about 7.5 % for the control as the mean of the two seasons. Whereas, dormex application at 1% each alone gave a higher percent of total loss than the oil application each alone or with dormex.

In this respect, El-Sheikh (2002) found that increasing storage temperature significantly increased weight loss in Le-Conte pear fruits. Also,

Tarabiah (2006) mentioned that total loss in peach fruit was gradually increased during marketing. Yet, Camphor oil at 0.1 % reduced the total loss in fruit weight than the control when sprayed two weeks before harvest.

From the present data it is clear that decayed fruits were the major one from total loss. Since, it presented more than 65% of total loss but the loss in fruit weight due to desiccation was less than 35% during the two seasons under the study.

B- Effect on changes of fruit characteristics :

Fruit firmness :

It is obvious from Table (4) that fruit firmness reduced from harvest till 6 days held at room temperature. The reduction in fruit firmness was about 20-27 % for these treatments during both seasons. The data also reveal that dormex application with winter oil at 2 % produced a lower reduction than the other treatments used or the control .Since, the reduction due to this treatment was about 19.7 and 20.6 % during the seasons, respectively while it ranged about 25.0 and 26.7 % for the control.

Table (4) : Changes in fruit firmness of Leconte pear fruits after 6 days at room temperature.

Treatments	Season 2005			Season 2006		
	Storage period in days					
	0	6	Loss %	0	6	Loss %
Control	13.2	9.9	**- 25.0 %**	13.5	9.9	**- 26.7 %**
Winter oil 2 %	14.2	10.4	**- 26.8 %**	13.8	10.3	**- 25.4 %**
Dormex 1 %	14.5	10.5	**- 27.6 %**	14.1	10.4	**- 26.2 %**
Dormex 2 %	14.8	10.6	**- 28.4 %**	14.6	11.4	**- 21.9 %**
Oil + Dormex 1%	15.6	12.3	**- 21.2 %**	14.1	12.0	**- 14.9 %**
Oil + Dormex 2%	14.7	11.8	**- 19.7 %**	14.1	11.2	**- 20.6 %**
L.S.D at 5 %	**0.517**	**0.770**	**----**	**0.791**	**0.784**	**---**

Total carotenoids :

Data from Table (5) indicated that total caroteniods in fruit skin of Leconte pear was increased after 6 days at room temperature than those at harvest time. The data also reveal that the increment in total carotenoids was higher in the first season than the second one. Yet, Dormex at 2 % gave a higher increment during both seasons of the study. Since, the increment due this treatment ranged about 44.3 and 12.5 during both seasons, respectively.

Table (5): Changes in total carotenoids of Leconte pear fruits after 6 days at room temperature.

Treatments	Season 2005			Season 2006		
	Storage period in days					
	0	6	Increment%	0	6	Increment%
Control	0.652	0.859	**31.8 %**	0.741	0.816	**10.1 %**
Winter oil 2 %	0.691	0.856	**23.9 %**	0.732	0.821	**12.2 %**
Dormex 1 %	0.623	0.872	**40.0 %**	0.742	0.829	**11.7 %**
Dormex 2 %	0.641	0.925	**44.3 %**	0.752	0.846	**12.5 %**
Oil + Dormex 1%	0.633	0.945	**49.3 %**	0.753	0.795	**5.6 %**
Oil + Dormex 2%	0.581	0.869	**49.6 %**	0.712	0.792	**11.2 %**
L. S. D at 5 %	**0.068**	**0.063**	**---**	**0.046**	**0.043**	**---**

SSC, total acidity and SSC/acid ratio :

From Table (6) it is clear that SSC was increased from harvest till 6 days held at room temperature after harvest time. The increment in SSC may be due to hydrolyses of starch to sugar under room temperature conditions. The data also reveal that dormex at 2 % produced a higher SSC after 6 days from harvest than the other treatments and the control. The increment in SSC due this treatment was about 26.2 and 24.1 during both seasons. Also, the increment for the untreated fruits was higher than the other treatments, since it gained about 25.7-26.0 % increment when held 6 days at room temperature conditions.

Table (6) : Changes in SSC % of Leconte pear fruits after 6 days at room temperature.

Treatments	Season 2005			Season 2006		
	Storage period in days					
	0	6	Increment%	0	6	Increment%
Control	10.1	12.7	**25.7 %**	10.4	13.1	**26.0 %**
Winter oil 2 %	10.6	12.3	**16.0 %**	10.6	12.9	**21.7 %**
Dormex 1 %	10.5	12.5	**19.1 %**	10.3	12.8	**24.3 %**
Dormex 2 %	10.7	13.5	**26.2 %**	10.8	13.4	**24.1 %**
Oil + Dormex 1%	11.8	12.2	**3.4 %**	11.7	12.7	**8.6 %**
Oil + Dormex 2%	11.7	13.2	**12.8 %**	11.6	13.7	**18.1 %**
L. S. D at 5 %	0.522	0.993	**---**	0.366	0.889	**---**

Table (7) presented the changes in total acidity during the storage period, from this data total acidity in fruit juice was increased as storage period advanced. Yet, no clear trend was obtained for dormex or winter oil application each alone or in combination.

Table (7): Changes in total acidity of Leconte pear fruits after 6 days at room temperature.

Treatments	Season 2005			Season 2006		
	Storage period in days					
	0	6	Increment%	0	6	Increment%
Control	0.265	0.295	11.3 %	0.276	0.294	6.5 %
Winter oil 2 %	0.272	0.294	8.1 %	0.278	0.299	7.6 %
Dormex 1 %	0.263	0.302	14.8 %	0.257	0.306	19.1 %
Dormex 2 %	0.270	0.317	17.4 %	0.268	0.320	19.4 %
Oil + Dormex 1%	0.278	0.309	11.2 %	0.273	0.309	13.2 %
Oil + Dormex 2%	0.283	0.301	6.4 %	0.287	0.305	6.3 %
L.S.D at 5 %	0.018	0.019	---	0.016	0.026	---

Furthermore, it is clear from Table (8) that SSC/acid ratio took almost similar trend to those obtained for SSC. Since, a gradual increase in SSC /ratio was obtained for both dormex or winter oil treatments. The increment in this value ranged about 7-13 % at the first season and 3.0-18.3 at the second one for these treatments from harvest till 6 days at room temperature.

It is also seen that the increment in the changes in SSC/acid ratio was almost lower to those obtained from the untreated fruits. Since, increment in the control in SSC/acid ratio was about 13.1-18.3 % during both seasons.

Table (8): Changes in SSC/acid ratio of Leconte pear fruits after 6 days at room temperature.

Treatments	Season 2005			Season 2006		
	Storage period in days					
	0	6	Increment %	0	6	Increment %
Control	38.1	43.1	13.1 %	37.7	44.6	18.3 %
Winter oil 2 %	39.0	41.8	7.2 %	38.1	42.6	11.8 %
Dormex 1 %	39.9	41.4	3.8 %	40.1	41.4	3.2 %
Dormex 2 %	39.6	42.6	7.6 %	40.3	41.5	3.0 %
Oil + Dormex 1 %	42.5	39.5	- 7.1 %	42.9	41.2	- 4.0 %
Oil + Dormex 2 %	41.3	43.9	6.3 %	40.4	44.5	10.2 %
L.S.D at 5 %	3.35	3.47	---	2.99	5.29	---

Regarding to the effect on changes in fruit characteristics, the obtained results revealed that fruit firmness of Leconte pear fruits were reduced through marketing at room temperature. Thus, both dormex and winter oil gave higher values than the other treatments or the control. Similarly, Hussein *et al*. (1997) reported that flesh firmness was decreased with increasing storage temperature. Furthermore, total caroteniods, soluble solids, total acidity and SSC/acid ratio in fruit juice were increased as storage period advanced from harvest till 6 days held at room temperature. Likewise, El-Sheik *et al*., (2002) reported that SSC was significantly increased as storage period advanced.

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تأثير الرش بالزيت المعدني الشتوي والدورمكس على خواص الثمار والكفاءة التخزينية لثمار الكمثرى الليكونت

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أجريت هذه الدراسة خلال عامي ٢٠٠٥ و ٢٠٠٦ بغرض دراسة أثر رش أشجار الكمثرى الليكونت بكل من الزيت المعدني الشتوي بتركيز ٢ % وكذا الدورمكس بتركيز ١ و ٢ % سواء بمفردهما أو معاً كمواد كاسرة للسكون على صفات الثمار وقت الجمع والكفاءة التخزينية لها أثناء التسويق تحت ظروف الغرفة العادية.

ولقد أوضحت الدراسة أن رش أشجار الكمثرى الليكونت بالدورمكس بتركيزي ١و ٢ % منفرداً أو مع الزيت المعدني الشتوي أدى لزيادة متوسط وزن وصلابة الثمار وكذا نسبة المواد الصلبة الذائبة للحموضة وقت الجمع.

علاوة على ما سبق فإن رش الأشجار بالزيت الشتوي بمفرده أو مع الدورمكس أدى إلى لخفض النسبة المئوية للفقد الكلى في الثمار مقارنة بالرش بالدورمكس بمفرده وكذا الثمار الغير معاملة.

كما أدى تخزين الثمار تحت ظروف الغرفة العادية لمدة ٦ أيام إلى خفض صلابة الثمار مع زيادة محتوى الثمار من الكاروتينات الكلية وكذا نسبة المواد الصلبة الذائبة للحموضة.

وتحت ظروف هذه الدراسة فإن رش الكمثرى الليكونت بالزيت الشتوي والدورمكس بتركيز ٢ % كان له أثر أفضل على تحسين خواص الثمار أثناء الجمع وكذا خلال التسويق من حيث المحافظة على صفات الجودة وكذا صلابة الثمار خلال فترة التداول.