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STUDIES ON REST INTENSITY AND CHILLING REQUIREMENTS FOR LE- CONTE PEAR CULTIVAR

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ABSTRACT

The intensity of the rest period in relation to environmental temperature fluctuating for Le-Conte pear cultivar was measured under laboratory conditions. Percent budbreak, accumulate chill units, ABA, GA_3 and IAA contents of buds were determined.

Le- Conte pear cultivar started to enter into dormancy in December while its budbreak was in March. Bud opening percent corresponded positively with increasing the chilling units.

ABA decreased quickly from Jan. to Mar. in Le-Conte buds, while GA_3 showed increasing level during Feb. Minimum IAA content resulted in Feb. and it reached its maximum level at budburst stage.

INTRODUCTION

Le-Conte pear cultivar is one of the important deciduous fruits grown in Egypt. It suffers from several factors which have a negative effect on its yield. Among these factors the depression of pear yield which is terminated by insufficient chilling during winter time. Several models for estimating chilling requirements and rest completion of different fruit species and cultivars have been developed. Weinberger (1950) used total hours ≤ 7.2 ^{o}C, and Gilreath and Buchanan (1979) used total hours $\leq 10^{o}$C. for estimating chilling requirements of some peach cultivars. Predication of rest completion, according to North Carolina, for "Red Delicious" apple has a border range of effective temperatures and a greater negative effect with temperatures above 70 ^{o}F (21^{o}C) for rest completion than the Utah model (Shaltout and Unrath, 1983). In a similar manner, Stino *et al*., (1986) proposed a chill unit equation for estimating of Santa Rosa and Methly plums in Egypt. Shaltout *et al*., 1987 stated the rest intensity of three low and two high chilling requirement peach cultivar. Siller-Cepeda *et at*., 1994 determined the bud physiological stages on Flame Seedless canes under laboratory conditions.

Abscisic acid was found to correlate with endo-dormancy and was able to induce dormancy in many plants (Addicott and Lyon, 1969; Wareing *et al.*, 1968 and Wareing and Phillips, 1970). The concentration of ABA in peach, grape and apricot buds exposed to chilling temperatures decreased during the endo-dormancy period (Corgan and Peyton, 1970; Ramsay and Martin, 1970 and Corgan and Martin, 1971).

Mokhtar (1988) postulated that a positive relationship occurred between chilling requirements and depth of endo-dormancy, since the low chilling cultivar i.e., Anna and Ein-Shamer had shallow deep dormancy and needed less chilling hours.

Gibberellic acid was found to be low at the onset of dormancy then increased as a result of chilling (Eagles and Wareing, 1964 and Williams and

Billingsley, 1970). It was found that application of GA is to be active in breaking dormancy of various fruit tree buds (Gomaa, 1984; Donoho and Walker, 1957; Erez *et al*., 1971; Hatch and Walker, 1969 and Walker and Donoho, 1959). In some cases GA_3 inhibited bud opening (Hull and Lewis, 1959). Application of 100 ppm GA_3 and warm field temperatures extended endo-dormancy period of peach (Walser *et al*., 1981). During bud swelling of pecan gibberellin likc substances occurred (Wood, 1983). It has been suggested that endo-dormancy in buds and seeds is regulated by a fluctuating, balance between endogenous growth promotores and inhibitors (Eagles and Wareign, 1964; Lavee, 1963; Walker and Seeley, 1973 and Wood, 1983).

Abscisic acid behavior differed between low and high chilling apple cultivars. However, in Anna apple cultivar (low chilling), ABA declined sharply from 1st December till mid-February, while changes of ABA was very slowly in the Stark Full Red Delicious cultuviar at the same period Concerning fluctuating of GA in Anna, its level decreased from 1st December till mid- January then increased during February, while stark Full Red Delicious did not show any specific trend. This may be due to the difference in their chilling requirements (Mokhtar, 1988).

The objectives of this investigation were (a) measure intensity of the rest period in relation to environmental temperaturing fluctuation the for Le-Conte pear cultivar (b) measuring individual plant hormones for buds of Le-Conte pear cultivar; and (c) determination the time of application of dormancy breaking agents.

METARIALS AND METHODS

This study was carried out in a private orchard located at Toakh in Kalubia governorate for two successive seasons 1997-1998 and 1998-1999 on Le-Conte pear cultivar. The trees are grapted on *Pyrus communis* rootstock and planted in 1985 at 5 meters apart, and treated with normal agricultural practices.

I. Determination of bud dormancy stage : was accomplished by collecting seventy - five shoots (twenty- five for each replicate) with 12-15 buds (10-12 nods), at two weeks intervals (from November to March), and evaluating the rate of bud emergence during three weeks under laboratory conditions as outlined by Shulman *et al* . (1983).

In the laboratory, shoots were defoliated immediately, and the basal three cm were immerged in plastic pots filled with tap water and placed at controlled room at 20-25^{o}C and normal photoperiod during the study. The water was changed every two days. The percentage of bud break was recorded after three weeks, to determine the dormancy stage. Buds were considered out of dormancy when 50% showed bud opening (Pouget, 1963).

II. Extraction Procedure: In different experiments, 2 to 5 gm. of buds were ground in cold 80% (V/V) aqueous methanol with a mortan and pestilet. The macerate was transferred to a flask with fresh methanol and the volume was adjusted to 20 ml of methanol for each gm fresh weight of buds. The tissue was allowed to extract for 24 hr. at OC and then was vacumnn filtered

through Whatman No. 42 paper. The filter paper and the residue were returned to the flask with a fresh volume of methanol shaken 30 min. on a wrist- action shaker, and filtered again. The procedure was repeated once more and the combined extracts were evaporated to the aqueous phase in a rotary flask evaporator., The aqueous phase (10 to 30 ml) was adjusted to pH 8.6 with 1% NaOH and partitioned three times with equal volumes of ethyl acetate. The combined ethyl acetate fraction was evaporated to dryness and held for further purification. The aqueous phase was adjusted to pH 2.8 with 1% HCl and partitioned three times with equal volumes of ethyl acetate. The remaining aqueous phase was discarded. The combined acidic ethyl acetate phase was reduced in volume (Fraction 1) to be used for GLC determination of acidic hormones such as IAA, ABA and GA_3 (Martin *et al*., 1982).

Randomized Complete block design of 3 replications with 5 trees plot was used. All data were statistically analysed by the standard methods (Snedecor and Cochran, 1990).

RESULTS AND DISCUSSION

Results of bud opening percent for one year old shoot are shown in Table (1) and Figs 1,2 from the beginning of November until the mid of March, for the two seasons under study. The tabulated data showed that gradually decreasing of bud opening percent until January 1th (3.98% and 2.82% in the two seasons respectively), and there were gradually increasing in the same percent (55.23% until the March 1th for the first season and 62.00% until the mid of March for the second season). These results are in agreement with those of Siller- Cepeda *et al*. (1994) who determined the bud physiological stages of Flame seedles canes under Laboratory conditions.

Table 1: Effect of date on bud opening percent for one year old shoot from Le-Conte pear cultivar after forcing period of 21 days at temperature 20-25ºC during two seasons (1997-1998) and (1998-1999).

Date	Angle	Bud opening percent	Angle	Bud opening percent
	(1997 - 1998)		(1997- 1998)	
Nov./1	39.72	40.86	38.80	39.27
Nov./15	54.87	66.26	50.11	58.88
Dec./1	34.18	31.58	32.50	28.87
Dec./15	13.75	5.87	11.50	4.00
Jan./1	11.52	3.98	9.68	2.82
Jan./15	14.86	7.27	17.35	8.90
Feb./1	25.77	18.97	23.50	15.54
Feb./15	37.17	36.48	34.45	32.0
Mar./1	47.98	55.23	40.11	41.53
Mar./15			51.94	62.00
L.S.D at 5%	1.731		1.067	

Our results showed that Le-Conte pear cultivar under study entered into endo-dormancy gradually and came out of it also gradually. Many investigators (Gilreath and Buchanan, 1979; Gomaa, 1984 and Shaltout and Unrath, 1983), Claimed that bud break was increased by increasing time of exposure to chlling hours. It is also clear that the Le-Conte- pear cultivar required time of chilling to terminate endo-dormancy. Under Egyptian

conditions, the total hours below or equal 7.2^{o}C were not satisfied and

theoretically buds would not be opened completely, delayed, and less crop will be obtained. This was confirmed by the fact that the effect of fluctuating temperature (5-15^{o}C and 5015 ^{o}C) were better or approximately equal to constant temperature of 5^{o}C. Erez and Lavee, 1971 found that effective of 10^{o}C was only 50% of effective as 6.1^{o}C for peach budbreak.

Under Kalubia governorate conditions, the maximum chilling hours below 7.2^{o}C were 129 hrs. in (1997-1998) and (1998 - 1999) seasons (Table 2), while the accumulated hours below 10^{o}C was 349.05 hrs. in the first seasons and 390.00 hrs in the second seasons. The percentage of accumulated chill units were 53.7% and 60.0% in the two seasons respectively.

Table 2:The percentage of accumulated chill units at optimum budbreak of Le-Conte pear cultivar, total hours $\leq$7.2^{o}C and total hours $\leq$ 10.0^{o}C [Data obtained from central laboratory for agricultural climate (CLACm MOA).

Season	(1997-1998	1998-1999
Chill units%	53.7	60.0
Total hours $\leq$ 7/2^{o}C	129.0	129
Total hours $\leq$10.0^{o}C	349.05	390.00

Data presented in Table (3) clearly revealed that accumulated chill units at bud break of Le-Conte and bud opening percent when the accumulated chill units was 402.0 in (1997-1998) and was 342.5 in (1998 - 1999) the percentage began to increase until March.

Changes of growth regulators in buds:

Abscisic acid, GA_3 and IAA were analyzed by GLC methods through the bud dormancy stages in Le-Conte pear cultivar (500-650 hours below or equal 7.2-10.0^{o}C) .

Data in Table (3) showed that level of free ABA was increased gradually through the period from the end of December until the end of January, after that it decreased gradually until the beginning of March, This trend coincided with the time of deep and termination of endo-dormancy. The lowest level of ABA was noticed the end of December (.001 g.100g/ 100 ml) and at the end of February (.0004 g/100g/ 100 ml), but the highest level of it was at the end of January (0.096g/100g/ 100 ml) .

Concerning the level of GA_3 in Le-Conte pear cultivar in Table (3) results showed that its level had decreased from the end of December till the end of January (from 0.861 to 0.504 g/100g/100 ml), then increased during February to the beginning of March or the period of bud break (from 0.504 to 0.632 g/100g/ 100ml).

On the other hand, It is evident from the present data in Table (3) and Fig (3) that there is a reduction in IAA at endo-dormancy in January comparing with its content in February until the beginning of March, then a sharply increase occurred till it reaches its maximum level at bud burst stage. The remarkable reduction of IAA content during endo-dormancy could be due to the transformation of the free indoles to bound indoles or bound auxins. This suggestion was confirmed by many investigators Epstein *et al*., (1986) and Bialek and Cohen (1989).

Table (3): Accumulated chill units at bud break of Le-Conte pear cultivar (C.U. Chill Units).

Date	C.U	Bud opening%	Total hourse $\leq$ 10.0 °C
		(1997-1998)	
Nov. 15	5.5	66.26	5.5
Dec.15	112.5	5.87	112.5
Jan. 15	402.0	7.27	402.0
Feb. 15	599.0	36.48	599
Mar. 15	677.5		677.5
		(1997- 1998)	
Nov. 15	6.0	58.88	6.0
Dec.15	71.5	4.00	71.5
Jan. 15	342.5	8.90	342.5
Feb. 15	579.5	32.00	579.5
Mar. 15	751.0	62.00	751.0

The obtained results are confirmed with those of Addicot and Lyon 1969; Wareing *et al*., 1968 and Wareign and Phillips, 1970. They found that ABA content correlated with endo-dormancy.

Table (4):Changes of ABA, GA_3 and IAA (as mg/100g/ 100ml) in Le-Conte pear cultivar buds during Endodormancy in 1998- 1999 season.

Date	ABA	GA_3	IAA
Dec. 31	0.001	0.861	0.002
Jan. 15	0.004	0.703	0.001
Jan. 31	0.096	0.504	0.001
Feb. 15	0.005	0.561	0.006
Mar. 1	0.0004	0.632	0.009

The results which were found by Hull and Lewis, 1959; Shaltout and Unrath, 1983 and Williams and Billingsely, 1970. Reported that GA_3 was not effective in breaking dormancy of apple buds or seeds. Endo-dormancy induction is often controlled by balance between growth promoters and inhibitors such as the GA/ABA ratio in many buds and seeds (Eagles and Wareing, 1964; Lavee, 1973 and Walker and Seley, 1973).

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دراسات على درجة السكون واحتياجات البرودة لصنف كمثرى ليكونت

على يسرى حلوه و عبد الرحمن الشيخ

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اجريت هذه الدراسة خلال موسمى (1997 - 1998) و (1998 - 1999) على عقل مأخوذة من اشجار كمثرى صنف ليكونت منزرعة بمزرعة خاصة عام 1985 فى أرض الوادى بمنطقة طوخ محافظة القليوبية .

تم أخذ 75 عقلة (25 لكل مكرره) يتراوح عدد البراعم فيها من 12-15 برعم كل اسبوعين ابتداء من نوفمبر الى مارس ووضعت فى اكواب من البلاستيك بها ماء وغمس بها 3 سم من الجزء القاعدى للعقل - كانت درجة الحرارة فى المعمل 20-25مْ - وكانت نسبة تحرك البراعم تحسب كل 21 يوم (3 اسابيع) بدأت البراعم فى السكون من شهر ديسمبر بينما بدأت فى التحرك فى أول شهر مارس - وكانت نسبة التحرك تزيد بزيادة تعرض البراعم لوحدات البرودة .

تناقص حامض الأبسيسك بسرعة من يناير الى مارس فى البراعم بينما أظهر حامض الجبرلين زيادة فى شهر فبراير . كان الاندول استيك آسيد أعلى كمية فى وقت انتفاخ البراعم .