

EFFECT OF DORMANCY BREAKING CHEMICAL AGENTS ON BUD DORMANCY OF "LE CONTE" PEAR

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ABSTRACT

This study was carried out during 2006 and 2007 seasons to study the effect of some dormancy - breaking chemicals on bud burst, vegetative and floral bud percentage and histological structure of buds of "Le Conte" pear trees. The data revealed that, spraying Le-Conte pear trees at 1st February with Dormex at 2% alone or at 1% combined with mineral oil at 3% as well as commercial fertilizer NPK at (4-5-40) 4% were more effective in bud burst as well as early of floral initiation and flower opening compared with control one, but Dormex application at 1% plus mineral oil at 3% was the best in this respect.

INTRODUCTION

Dormancy is a phase of development that occurs annually in deciduous fruit trees. Release of dormancy requires accumulated chilling during winter, followed by a rise in temperature in the spring (Fuchigmi *et al.*, 1982). The major one of economic production of deciduous fruit trees in subtropics and tropics is the insufficient period of chilling temperature. In this respect, inadequate chilling may result in poor and uneven bud break, reduced and delayed foliage development, sparse bloom, abnormal flower development, poor fruit set and / or early growth cessation (Erez, 1987).

Dormancy breaking agents have been used in warm regions for controlling bud break of pears trees, where the chilling requirements are not sufficient naturally. Some chemicals have been used to accelerate bud burst such as thiourea (Sourial *et al.*, 1993); hydrogen cyanamide and mineral oil (Stino, 1997) and potassium nitrate (Shahin *et al.*, 1997).

Changes in endogenous bud substances which may play a role in breaking dormancy have not been accurately determined (Ramina *et al.*, 1995). Therefore, the purpose of the present investigation was to study the effect of some dormancy - breaking chemicals on bud break, vegetative and floral bud percentage and histological structure of buds of "Le Conte" pear trees.

MATERIALS AND METHODS

The present study was carried out during the three successive seasons of 2005, 2006 and 2007 (the first season was conducted to select the best concentration of each material under study) on "Le Conte" pear to evaluate the effect of Dormex (hydrogen cyanamide 49 %), mineral oil and the commercial fertilizer NPK (4-5-40) as a dormancy breaking chemicals on bud constituents, bud break and histological structure of buds of "Le Conte" pear trees.

"Le Conte" pear (*Pyrus communis* L. x *Pyrus pyrifolia* N.) trees were fourteen years old, budded on *Pyrus communis* rootstock, spaced at 5 meters apart grown in sandy soil under drip irrigation system and modified central leader trained in a private orchard at El-Khatatba city, Monifia Governorate.

Forty eight trees, uniform in growth and vigor and in good physical condition were selected for this study. Treatments were replicated three times each replicate represented by two trees in complete randomized block design to present the following treatments as follows:

- 1) Dormex at 1%.
- 2) Dormex at 1% + Mineral oil at 3%.
- 3) Dormex at 2%.
- 4) Dormex at 2% + Mineral oil at 3%.
- 5) Agro-Top (NPK, 4-5-40) at 4%.
- 6) Agro-Top (NPK, 4-5-40) at 4% + Mineral oil at 3%.
- 7) Mineral oil at 3%.
- 8) Control (sprayed with tap water).

Pear trees sprayed on 1st February with average 214 chilling hour at 7°C for the two seasons and Super Film at 0.1% was used as a surfactant in all treatments.

In each growing season, four main branches as uniform as possible were chosen at the four cardinal points of each experimented tree, tagged and the number of buds on these branches were counted before applying treatments. In all seasons, the number of bursted buds, the developed flower and leaf buds were counted and expressed as percentages.

Histological studies:

For the anatomical studies, specimens were taken from the lateral buds of two weeks after dormancy breaking chemicals application. The samples were immediately killed and fixed in FAA solution (85 ml ethyl alcohol 70%, 10 ml formalin and 5 ml glacial acetic acid); dehydrated in ethanol alcohol series, cleared and embedded in paraffin wax (55-58°C-m-p). Longitudinal sections 20 µ thick were prepared by rotary microtome, stained with saffranin – light green combination, cleared in oil cloves and mounted in canada balsam (Gerlach, 1977) for microscopically examination and photography.

Statistical analysis:

The present data was statistically analyzed according to the methods described by (Snedecor and Cochran, 1980) and the means were compared statistically using Duncan's multiple range at 5% level of probability.

RESULTS AND DISCUSSION

The effect of Dormex, Mineral oil and Agro-Top on bud burst and histological structure of buds of "Le Conte" pear trees are presented as follow:

I. Effect on date of bud burst and bud burst percentage:

The effect of different dormancy breaking agents on the percent of bud burst of Le-Conte pear trees during the seasons of 2006 and 2007 are

presented in Table (1). It is clear from this table that all treatments used significantly increased the percent of bud burst than the control. As well as, Dormex at 1% or 2% with mineral oil at 3% hastened bud break since the bud sprouted by 23 and 24.5 days after treatment as means of two seasons. So, these treatments hastened the bud burst earlier than using Dormex alone. Yet, using mineral oil alone at 3% sprouting the buds later than Dormex, but earlier than the untreated trees which induced bud break by about 41 days after the time of spraying. Our results go in line with those reported by Mann *et al.*, (1994) who found that Dormex treatments advanced bud burst by 2 weeks in pear trees Cv. Baggugosha. Also, Mokhtar *et al.*, (1994) reported that hydrogen cyanamide application resulted in an early bud break of pear trees. Furthermore, Gabr (1996) found that spraying Le Conte pear trees with Dormex caused an earlier bud break by 12-15 days. At least, Harmender and Mann (2002) showed that spraying pear Cv. Pathernakh trees with Dormex at 1, 2, 3 and 4 % and thiourea at 1 and 2% advanced bud burst by 10 days.

Moreover, the percent of bud burst ranged from 88 % to 100 % in treated trees, compared with 71.6 % in the control as means of both seasons. In this respect, the data showed a positive correlation between bud burst percentage and Dormex concentration. Since Dormex at 2 % significantly increased the bud burst in pear trees than those sprayed with 1 %. Yet, Dormex at 1 % + mineral oil at 3 % treatment gave the highest significant effect in this respect since, the percent was about 100 % as mean of two season. That is may be due to the superiority of Dormex to increase bud peroxidase activity and decrease catalase one that the inhibited effect on catalase activity causes arise in H₂O₂ content and an increase on peroxidase activity in the treated buds. This is turn keeping NADP in an oxidized form which could lead to activate the pentose-phosphate pathway. This activation inducing bud break and subsequent intensive growth after bud break, (Kurado *et al.*, 1990 and Nir and Lavee, 1993). Moreover, Cyanamide stimulated the production of cytokinins in the bud which appears to be an alternative to the root system as a source of cytokinin during rest termination and may act as an initiator of growth, (North *et al.*, 1990). In the same line, (Hegazi *et al.*, 1999) found that hormone contents in the floral buds were increased with the application of Dormex and the levels of IAA and GA₃ were highest at 15-17 days after spraying date. Generally, bud burst seems to be controlled by the balance between plant hormones rather than a single ones. Also, breaking of dormancy was not dependent on the reduced bud level of endogenous ABA, but rather on an accumulation of endogenous stimulators. Also, Foot (1987) reported that Dormex penetrates in bud scales, gets absorbed in buds and initiates the processes leading to bud break. Our data go in line with those reported by (EL-Sheikh, 2000 and Harminder and Mann, 2002).

Sprayed pear trees with NPK alone or with mineral oil also increased the percentage of bud burst than the control, but the effect of these treatments was almost lower than Dormex at 1 % plus mineral oil at 3 % treatment. Yet, NPK at 4 % alone gave a higher effect on bud burst percentage than when mixed with mineral oil or the control. Since, the bud burst due to this treatment was about 95.87 % as a mean of two seasons.

That is due to that NPK alone resulted in significant increase in sorbitol concentration. While, the effect of NPK mixed with mineral oil treatment depressed sorbitol level which could play a role in bud break through its effect in increasing osmotic potential in bud tissues. It is well known that sorbitol is the most widely distributed poly sugar in nurture, (Rashad, 1993). Moreover, Nonhebel *et al.* (1993) revealed that N - supply leads to an increase in amino acids synthesis, for example tryptophan, which is directly related to IAA synthesis. Furthermore, K ions play an important role to adjust and keep an osmotic potential in bud tissue and P is an essential element for phospholipids and lenolic acid in structure of plasmalema membranes (Erez *et al.*, 1997).

On the contrary, mineral oil at 3 % treatment gave the lowest effect in this respect. Since, the percent attributed due this treatment was about 88 % as a mean of two seasons. This result could be due to the effect of mineral oil on decreasing the activity of catalase, (Nir and Lavee, 1993). The obtained data were in harmony with those reported by (Tawfik *et al.*, 2002 and EL-Sabrou, 2005).

Table (1): Effect of Dormex, mineral oil and NPK on date of bud burst and bud burst percentage.

Treatment	Number of Days from spray to bud burst			Bud burst%		
	Season 2006	Season 2007	Mean	Season 2006	Season 2007	Mean
Dormex 1%	29	27	28	94.63	95.67	95.15
Dormex 1% + Mo 3%	24	22	23	100.00	100.00	100.0
Dormex 2%	30	27	28.5	98.13	99.17	98.65
Dormex 2% + Mo 3%	25	24	24.5	97.47	96.47	96.97
Mineral oil at 3%	35	32	33.5	85.62	90.30	87.96
NPK at 4%	31	29	30	95.87	95.87	95.87
NPK at 4%+ Mo 3%	32	29	30.5	92.43	92.43	92.43
Control	42	40	41	65.90	77.60	71.60
L.S.D at 5%	1.73	1.73	1.32	1.51

Abbreviation: NPK = Commercial fertilizer named Agro-Top (4-5-40).
MO = Mineral oil named folk oil.

II. Effect on the percent of vegetative and floral buds:

Data from Table (2) indicated that the control showed a higher percent of vegetative bud. Since, it presented about 25.15 % as a means of the two seasons. Yet, mineral oil alone at 3 % gave a lower percent of vegetative bud comparing with the other treatments. Likewise, NPK at 4 % with mineral oil at 3 % reduced the vegetative bud percentage while, Dormex at 1 % alone or with mineral oil at 3 % were more effective in diminishing the percentage of vegetative bud than that which was obtained from Dormex at 2 % alone or with mineral oil. These results were in the same trend among both of seasons.

Referring to the effect of dormancy-breaking agents on floral bud percentage, it is obvious from Table (2) that all treatments used increased the floral bud percentage than the control. AS well as, Dormex application

at 1 % with mineral oil at 3 % gave a higher significant effect for increasing the floral bud percentage than the other treatments used or the control. Also, NPK application at 4 % with mineral oil at 3 % increased the percentage of floral bud than sprayed with NPK alone. Furthermore, the other treatments except the control enhanced the floral bud percentage since, control trees present about 46.6 % as a means of the both seasons. These results agreed with those reported by Gabr (1996) Which found that sprayed Le Conte pear trees with Dormex increased the percentage of the developed floral buds. In addition, (Aly *et al.*, 1998) mentioned that Dormex increased floral bud burst percentage. Moreover, EL-Sabrou (2005) reported that spraying Le Conte pear trees with Dormex at 1.5%, mineral oil at 3% + thiourea at 1.5% + potassium nitrate at 1.5% and mineral oil at 3% + Urea at 3% + potassium nitrate at 1.5% treatments gave significant higher floral bud percentage compared with the control. In the meantime, (Stino, 1997) mentioned that Dormex at 1.5% enhanced floral bud burst and accelerated full flowering of Anna apple. At least, Mohamed *et al.*(1995) reported that the average percentage of floral buds on one-year-old shoots of Anna apple increased by Dormex at all experimented dates as well as Urea + Universal on January 6th or 21st

Table (2): Effect of Dormex, mineral oil and NPK on vegetative and floral bud percentages of Le – Conte pear.

Treatment	Vegetative bud%			Floral bud%		
	Season 2006	Season 2007	Mean	Season 2006	Season 2007	Mean
Dormex 1%	9.05	10.59	9.82	85.58	85.08	85.33
Dormex 1% + Mo 3%	7.03	6.94	6.99	92.97	93.06	93.02
Dormex 2%	17.48	18.70	18.09	80.65	80.47	80.56
Dormex 2% + Mo 3%	13.06	11.83	12.45	84.41	84.64	84.51
Mineral oil at 3%	1.89	2.33	2.11	83.73	87.97	85.85
NPK at 4%	19.64	19.78	19.71	76.23	76.09	76.16
NPK at 4%+ Mo 3%	3.59	3.42	3.51	88.84	89.01	88.91
Control	19.81	30.49	25.15	46.09	47.11	46.6
L.S.D at 5%	1.76	1.57	1.67	1.61	1.17	1.39

Abbreviation: NPK = Commercial fertilizer named Agro-Top (4-5-40).
MO = Mineral oil named folk oil.

III. Histological structure of buds:

The axillary dormant buds of "Le Conte" pear is mixed bud, contains many thick scale leaves and some epidermis cells developed into long hairs (Fig.1). The epidermis of scale leaves covered with a thick cuticle layer (Fig.2). The flower is bisexual, the anther are crowded together around the two styles and some of them dehiscence produce abundant pollen grains (Fig.3).

The results in Table (1) indicated that application of Dormex at 2% alone (Fig.4) or combined with mineral oil at 3% (Figs. 5,6 and 7) as well as application of commercial fertilizer (NPK) at 4% (Fig.8) were more effective on percent of bud burst. Whereas, the highest percent value was obtained with Dormex at 1% plus mineral oil at 3%.

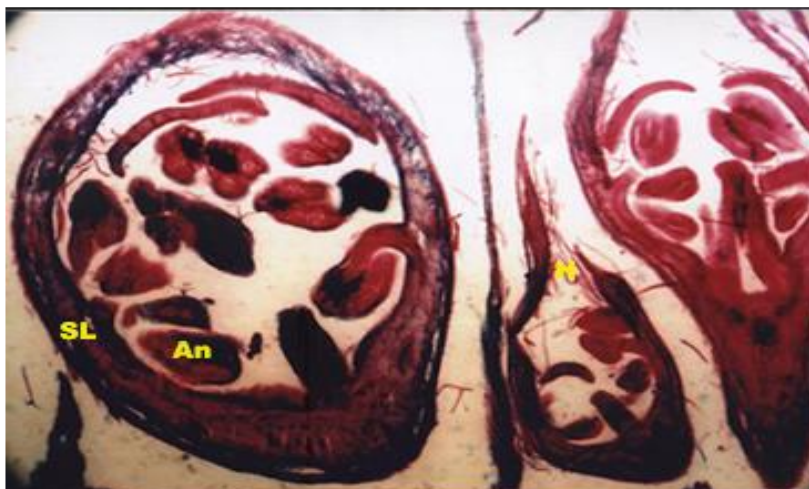
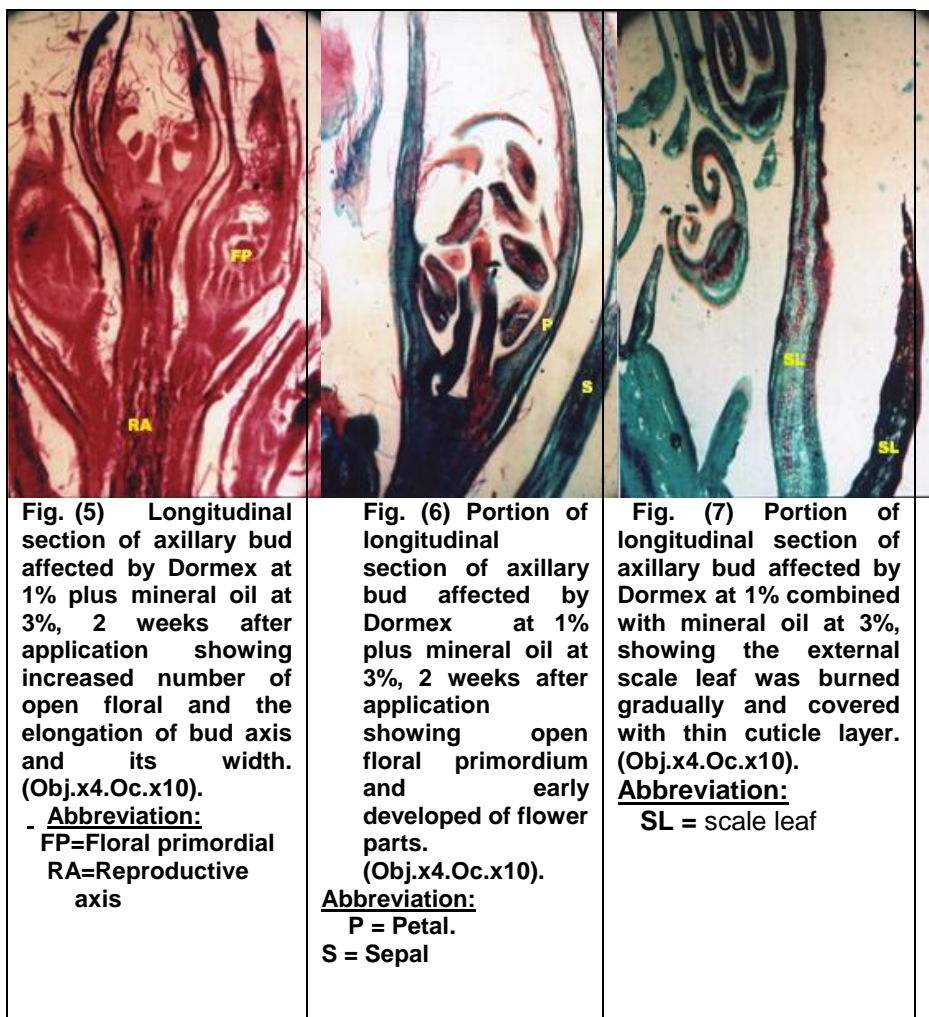


Fig. (1): Longitudinal section of untreated bud, two weeks from application showing that some floral primordial still close. (Obj.x4.Oc.x10).

Abbreviation: [SL = Scale leaf An = Anther H = hairs]

<p>Fig. (2): External portion of longitudinal section of untreated axillary bud show that the bud crowded by thick scale leaves. (Obj.x10.Oc.x10).</p> <p><u>Abbreviation:</u> CU = Cuticle.</p>	<p>Fig. (3):Portion of longitudinal section of untreated axillary bud show that the close floral primordium, the bisexual flower with many anthers which produce abundant pollen grains. (Obj.x4.Oc.x10).</p> <p><u>Abbreviation:</u> PG = Pollen grains ST =Style</p>	<p>Fig. (4): Longitudinal section of axillary bud affected by Dormex at 2% alone, 2 weeks after application showing open floral primordial with burned the tips of scale leaves. (Obj.x4.Oc.x10).</p> <p><u>Abbreviation:</u> RA = Reproductive axis.</p>



The effect of these above mentioned treatments on bud break accompanied with many anatomical changes in both scale leaves and floral primordia as follows:

Regarding the results in (Fig.4) indicated that treatment with Dormex at 2% alone or at 1% combined with mineral oil at 3% (Fig.5) increased the elongation of reproductive axis as well as its width and number of open floral primordia compared with other treatments or control one which showed some floral primordia still close. (Fig.1). Moreover, Dormex at 1% combined with mineral oil at 3% treatment showed induction of early bud burst and opens as well as promoted floral initiation development (Fig.5). In addition, flowering occurred more rapidly and early stages of flower parts were development (Fig.6).

The most striking anatomical differences were observed in treated buds can be summarized as follows:

The beneficial effects of Dormex on dormancy breaking, induction of early bud burst and early development of the flower may be attributed to its ability penetrates in bud scales and absorbed in buds (Harmander and Mann, 2002), as well as increased IAA, GA₃ and cytokinins but decreased ABA contents in the buds (Hegazi *et al.*, 1999). Furthermore, (Arteca, 1996) reported that IAA and cytokinins increased cell elongation, swelling of tissue and cell division. Also, GA₃ increased cell wall extensibility and cell elongation.

Concerning, the stimulative effects of commercial fertilizer NPK on bud it may be attributed to its effect on increasing endogenous plant hormones (Ghallab and Salem, 2001) which increase cell division and cell elongation (Arteca, 1996). Moreover, (Arisha and Bardisi, 1999) reported that nitrogen is an essential element for building up protoplasm, amino acids and proteins which induce cell division and cell elongation.

From the above mentioned results could be concluded that Dormex application at 2% alone or at 1% combined with mineral oil as well as commercial fertilizer NPK at 4% were more effective in bud break and bud burst as well as early of floral initiation and flower opening compared with control one.

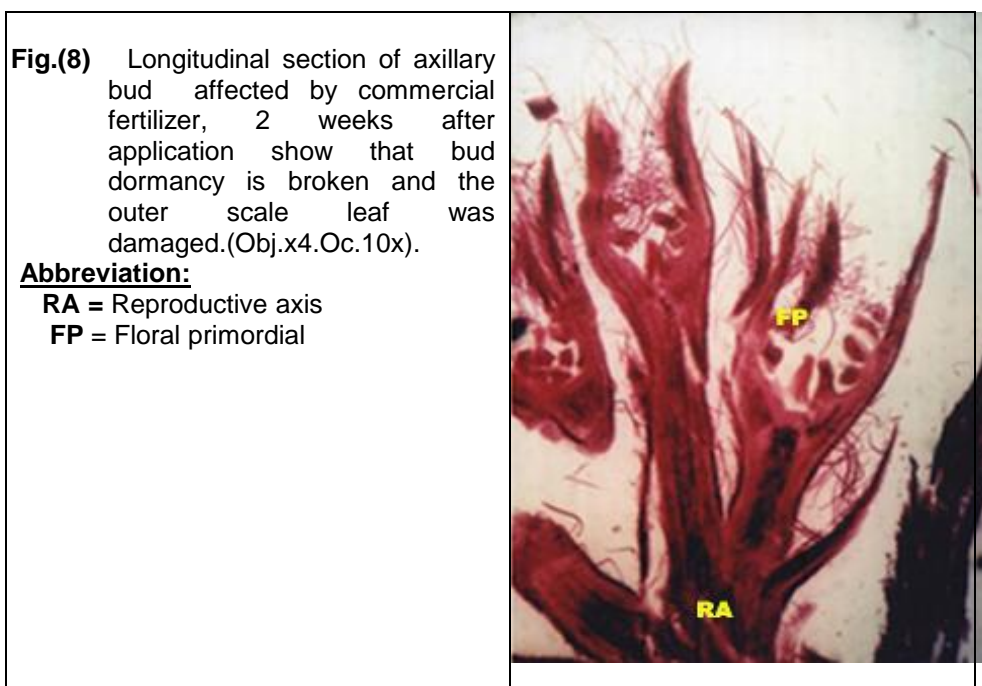
The scale leaves appeared narrow (Fig.6), burned gradually from the external to the internal scale and from the terminal to the basal parts of each one (Fig.7). Similar observed reported by (Fahn, 1990) who found that the transition period to the flowering characterized with an increase in the longitudinal growth of the axis due to cell division and cell elongation as well as scale leaves become narrow.

Concerning, the effects of mineral fertilizer NPK at 4% on bud burst and floral development, it is clear that treatment with commercial fertilizer at 4% increased the elongation of reproductive axis and number of flower development. The outer scale leaf appeared burned and finally was broken (Fig.8).

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**تأثير العوامل الكيميائية الكاسرة للسكون على سكون البراعم في الكمثرى الليكونت
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أجريت هذه الدراسة خلال موسمي ٢٠٠٦ – ٢٠٠٧ لدراسة تأثير بعض المواد الكيميائية الكاسرة للسكون على النسبة المئوية لتفتح البراعم الخضرية و الزهرية و التركيب التشريحي لبراعم أشجار الكمثرى الليكونت.

لقد أوضحت النتائج أن رش أشجار الكمثرى الليكونت في أول فبراير بالدورمكس بتركيز ٢% بمفرده أو ١% مع الزيت المعدني بتركيز ٣% و كذلك السماد التجاري NPK (٤٠ - ٥ - ٤) بتركيز ٤% كانت أكثر تأثيراً على نسبة تفتح البراعم و كذلك تكبير التزهير مقارنة بالأشجار الغير معاملة و لكن كانت المعاملة بالدورمكس بتركيز ١% مخلوطاً مع الزيت المعدني بتركيز ٣% هي الأفضل.