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EFFECT OF SOME CULTURAL PRACTICES ON FLOWER BUD FORMATION, FRUIT SET AND YIELD OF 'LE-CONTE" PEAR TREES

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ABSTRACT

Ten-years-old "Le-Conte" pear trees on *Pyrus communis* rootstock at El-Kanater Horticultural Research Station, Egypt, were treated as follows: (1) Shoot bending (tying shoots down to be nearby at horizontal position, (2) Tip pruning (removal a distal portion of the long shoots), (3) Shoot bending + tip pruning,(4) defoliation (removal of all leaves by spraying trees with 10% urea solution, (5) Shoot bending + defoliation., (6) tip pruning + defoliation, (7) Shoot bending + tip pruning + defoliation, (8) Girdling the limbs with 9 mm width, (9) Control. Shoot bending and girdling were carried out 7 days after full bloom tip pruning was done at the beginning of June, while defoliation treatment was done in the end of November.

All treatments decreased shoot length especially treatment of shoot bending + tip pruning + defoliation, however, number of leaves and leaf area increased. The combined treatments were better than single ones. The treatments caused an increase in spur percentage, fruit set and yield. The best treatment was shoot bending + tip pruning + defoliation followed in descending order by treatments of shoot bending + defoliation, tip pruning + defoliation, and shoot bending + tip pruning. Girdling treatment gave the best fruit weight, volume, height and diameter followed by the combined treatment, however, differences of the resulted values of fruit firmness, total soluble solids and acidity were insignificant.

INTRODUCTION

Flower buds of pear are formed on terminal of shoots and short spurs of 2-years- old and older. Flower bud development can be altered by many factors and practices.

Shoot bending may enhance flowering of young trees, encourage the development of flower buds and increase yield in apple trees (Isac, 1986; Wei, 1987 and Edwards and Notodimedjo, 1987) and in pears (Lin , *et al*., 1990 and Chen Chung, *et al.,* 1997.

Shoot bending treatments also caused a rapid increase in the number of nodes in the axillary buds in Japanese pear (Pyrus serotina Rehd) and the final percentage of flower bud formation in the control only reached 15.2% compared with approximately 60% for the treated shoots (Banno, et al., 1985.

Girdling apple limbs or trees inhibited vegetative growth (Greene, and Lord, 1978 & 1983) and promoted the formation of flower buds, thereby increasing bloom density, fruit set, fruit size and yield (Dennis, 1968; Greene and Lord, 1978; Dennis, 1987; Wei, 1993; and Li-Tain *et al.*, 1996). Moreover, Starch accumulation in leaves was reported after girdling (Avery*, et al.,* 1979).

Defoliation, branch bending and tip pruning are used to varying extents in the commercial culture of apples in the Batu region of Java, Indonesia

to stimulate bud burst. It was found that defoliation had the greatest effect on bud burst and thus on subsequent growth and cropping (Edwards and Notodimedjo, 1987). However, defoliation which made immediately after harvest in Golden Delicious apple caused a marked reduction in fruit set and yield as a result of the reduction of translocation of nitrogen, phosphorus and potassium which normally stored in the bark (Faby and Naumann, 1986).

Chemical defoliation of apple by copper sulphate or urea, enhanced bud opening and the results were better than those of hand defoliation (Diaz, *et al.,* 1987).Shoot tipping produced more lateral bud break, the highest number of branches and greatest total branch length of stool bed shoots of M.M. 106 EMLA and M. 26EMLA apple rootstocks (Quellette and Young, 1994).

The main objective of this work is to study the effect of some cultural practices on flower bud formation, fruit set and yield of "Le-Conte" pear trees.

MATERIALS AND METHODS

This study was carried out during (1997/1998) and (1998/1999) seasons on 10 years old "LeConte" pear trees grafted on *Pyrus communis* rootstock and planted at 5 meters apart at El-Kanater Horticultural Research Station, Kalubia Governorate Egypt. All horticultural practices were performed as recommended in Kalubia Governorate.

Twenty seven trees nearly uniform in growth and vigour were selected and grouped under nine treatments. Treatments were replicated three times each represented by a single tree in complete randomized blocks design. The treatments were as follows:

T1. Shoot bending (tying shoots down to be nearby at horizontal position).
T2. Tip pruning (removed a distal portion of the long shoots).
T3. Shoot bending + tip pruning.
T4. Defoliation (removal of all leaves on the tested trees by spraying them with 10% urea solution.
T5. Shoot bending + defoliation.
T6. Tip pruning + defoliation.
T7. Shoot bending + tip pruning + defoliation.
T8. Girdling the limbs with 9 mm width.
T9. Control, trees left without treatment.

Shoot bending, and girdling were carried out during 1997 and 1998 years 7 days after full bloom, tip pruning was done at the beginning of June, while defoliation treatment was done in the end of November. Data were obtained during 1998 and 1999 seasons.

Length of eight sprouts on the shoot was measured on mid April and on mid August and average increment in length was calculated. The increase in leaf number also was determined and the leaf area in adult leaves was measured using a planimeter according to Nautiyal, *et al*. (1990). Percentage of flowered spurs on the shoot was calculated and percentage of fruit set as well as tree yield in Kg were recorded. Sample of 15 matured fruits was picked from trees under

each treatment and examined to study the effect of tested treatments on certain fruit characteristics, fruit weight, volume, height and diameter. Fruit firmness was also estimated by Magnese-Taylor type pressure tester which has a standard 5/16 of inch plunger and recorded as lb/Inch^2. Total soluble solids of fruit juice were estimated using a hand refractometer. Total acidity (%) was calculated as gm malic acid/100gm fresh weight (A.O.A.C., 1960).

Obtained data were statistically analyzed according to Snedecor and Cochran (1990). Differences were compared by using L.S.D. values at 5% level.

RESULTS AND DISCUSSION

Table (1) shows the effect of of some cultural practices on sprouts growth and flowering in "LeConte" pear trees.

1. Shoot length

It was found that all treatments caused a significant decrease in shoot length compared with control during 1998 and 1999 seasons. The greatest decrease was realized as a result of: shoot bending + tip pruning + defoliation, followed in descending order by tip pruning, shoot bending + tip pruning, tip pruning + defoliation, girdling, and shoot bending + defoliation. However, defoliation or shoot bending tabulated the least decrease in shoot length.

That decrease in shoot growth was previously reported as a result of : shoot bending by Banno*, et al.* (1985); girdling by Greene and Lord (1978, 1983). However, Qullette and Young (1994) reported that shoot tipping resulted in greatest total branch length in apple rootstocks.

2. Number of leaves

Table (1) shows a significant increase in number of leaves per shoot due to the tested treatments. This increasing effect was in descending order for shoot bending + tip pruning + defoliation, shoot bending + tip pruning, tip pruning + defoliation, tip pruning, shoot bending, and shoot bending + defoliation treatments.. However, both of defoliation and girdling treatments gave the least increase in leaves' number.

These results are in harmony with the findings of Greene and Lord (1978) and Edwards and Notodimedjo (1987) who reported that as a result of shoot growth reduction more nodes and leaves per shoot were formed. It was shown from the same data that shoot bending, tip pruning and defoliation treatments were the best ones to minimize relatively the growth, however defoliation, girdling treatments were more effective in restricting growth than other treatments. This effect may be the cause of the least increase or the decrease of number of leaves as a result of these two treatments.

3. Leaf area

As shown in Table (1) all treatments showed a significant increase in leaf area than control. The largest increase was obtained by shoot bending + tip pruning + defoliation treatment followed in a descending order by the

treatments of defoliation, tip pruning + defoliation , shoot bending + defoliation, shoot bending + tip pruning, girdling, tip pruning and shoot bending.

Such results are in harmony with those reported by Edwards and Notodimedjo (1987) concerning defoliation, bending and tip pruning of apple trees under tropical conditions.

4- Flowered spurs percentage

From Table (1), it was found that all treatments showed a significant increase in flowered spurs percentage than control. The highest percentages were realized as a result of the treatments of shoot bending + tip pruning + defoliation, shoot bending + defoliation, tip pruning + defoliation, and shoot bending + tip pruning treatments, respectively.

These findings are in harmony with the reported results due to shoot bending by Isac (1986), Wei (1987) and Edwards and Notodimedjo (1987), in apples and Banno, et al. (1985), Lin, *et al.* (1990) and Chen-Chung, *et al.* (1997) in pears, girdling by Greene and Lord (1978) & (1983) and tip pruning and defoliation by Edwards and Notodimedjo (1987.

5- Fruit set percentage

Table (2) shows the effect of cultural practices tested on fruit set percentage, yield and yield increment. Data clearly showed that all treatments increased percentage of fruit set. The greatest increase was obtained as a result of the shoot bending + tip pruning + defoliation treatment followed in descending order by the treatments of shoot bending + defoliation treatment, tip pruning + defoliation , shoot bending + tip pruning, Girdling, shoot bending, defoliation and tip pruning. It was obvious that the combined treatment was better than the single ones because of the additive effect of more than one operation in the same treatment.

These results are in harmony with the findings of Dennis (1968), Greene and Lord (1978), Dennis, *et al*. (1987), Wei (1993) and Li *et al*. (1996) concerning the effect of girdling apple trees, Lin, *et al.* (1990) and Chen-Chung, *et al*. (1997) concerning shoot bending of pear trees, Edwards and Notodimedjo (1987) concerning defoliation, branch bending and tip pruning of apple trees. The increase due to the effect of defoliation in this study was obtained as a result of the time of defoliation which was in the end of November. However, the reductiion of fruit set which was reported by Faby and Naumann (1986) was attributed to early defoliation which made immediately after harvest in “Golden Delicious” apple.

6. Yield and yield increment

Data presented in Table (2) show that all treatments increased significantly tree yield of “LeConte” pear during 1998 and 1999 seasons. Best results were attained as a result of the combined treatment of shoot bending + tip pruning + defoliation. The combined treatments of shoot bending + defoliation, tip pruning + defoliation and shoot bending + tip pruning were more effective than the single treatment of girdling, shoot bending, defoliation and tip pruning. Yield increment percentage was 38.42% and 40.13% for the combined

treatment of shoot bending + tip pruning + defoliation during 1998 and 1999 seasons, respectively. Likewise the increment in yield for shoot bending + defoliation treatment was 32.28% and 38.21%, respectively during the two successive seasons, however, that increment was minimized to the percentage of 15.02% and 8.39% for the single treatment of tip pruning during seasons of 1998 and 1999, respectively. These results are in line with those of Dennis (1968); Greene and Lord (1978); Isac (1986); Dennis, *et al*. (1987); Edwards and Notodimedjo (1987); Lin, *et al*.; Wei (1993); Li-Tain, *et al.* (1996) and Chen-Chung, *et al*. (1997).

Table (2): Effect of some cultural practices on pear fruit set, Yield and yield increment during seasons of 1998 and 1999.

Treatments	Fruit set %		Yield (Kg/tree)		Yield increment %	
	1998	1999	1998	1999	1998	1999
T1. Shoot bending	11.84	12.84	14.78	15.66	22.66	20.64
T2. Tip pruning	10.65	12.03	13.86	14.07	15.02	8.39
T3. Shoot b. + tip p.	12.93	14.15	15.79	17.12	31.03	31.89
T4. Defoliation	11.26	12.35	14.59	15.14	21.07	16.64
T5.Shoot b.+ defoliation	13.03	14.46	15.94	17.94	32.28	38.20
T6. Tip p. + defoliation	12.94	14.38	15.90	17.33	31.95	33.51
T7. Shoot b. + tip p. + defoliation	13.66	15.87	16.68	18.19	38.42	40.13
T8. Girdling	11.97	13.20	14.78	16.54	22.65	27.42
T9. Control	9.87	10.56	12.05	12.98	0.0	0.0
L.S.D. at 5%	2.09	2.54	0.45	0.63	3.17	3.98

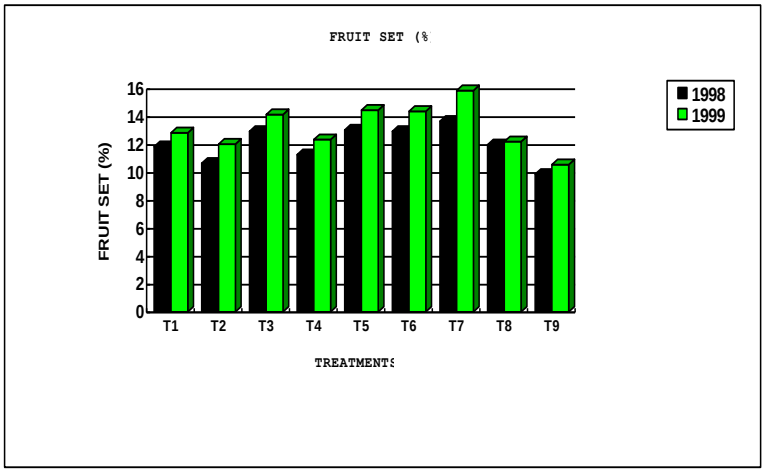

Figure (1): Graphic constructions showing effect of some cultural practices on pear fruit set during seasons of 1998 and 1999.

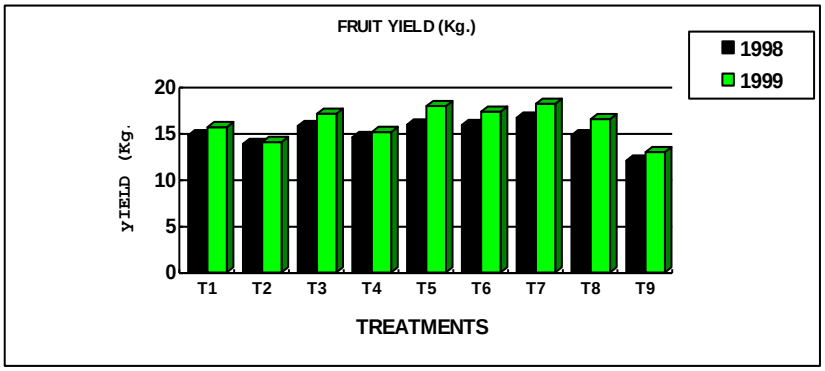

Figure (2): Graphic constructions showing effect of some cultural practices on pear yield (Kg) during seasons of 1998 and 1999

7. Fruit characteristics

Fruit characteristic results of "LeConte" pear are tabulated in Table (3).

a) Fruit weight and volume

The concerned data indicated that all treatments significantly increased fruit weight (gm) and volume (ml). The best treatment in this respect was girdling treatment , followed by shoot bending + tip pruning + defoliation treatment, tip pruning + defoliation treatment, shoot bending + defoliation and shoot bending + tip pruning, respectively. Avery*, et al*. (1979) reported that starch accumulation in leaves was found after girdling. That is may be the cause of the largest fruit weight and volume of girdling treatment. Moreover, the combined treatment was better than each of single treatment for increasing fruit weight and volume, however, the least increase was realized due to both of defoliation and tip pruning.

These results are in harmony with the findings of Dennis (1968); Greene and Lord (1978); Banno, *et al.* (1985); Wei (1993) and Li-Tain*, et al.* (1996).

b-Fruit diameter and height

It was found that fruit diameter and height follow the same trend of fruit weight and volume. The best increase in fruit diameter and height was obtained as a result of girdling treatment followed by the combined treatment and the single treatment, respectively, however, the least increase was in defoliation treatment. In this connection, Dennis (1968); Greene and Lord (1978),; Dennis, *et al.* (1987); Wei (1993) and Li-Tain*, et al*. (1996) found that girdlling increased the size of apple fruits.

C) Fruit firmness

Data in Table (3) showed that the differences in fruit firmness were not significant in both seasons, but it can be noticed that all treatments decreased

fruit firmness. The least firmness was obtained as a result of girdling treatment followed by shoot bending + tip pruning + defoliation treatment, tip pruning +

defoliation, shoot bending + defoliation, shoot bending + tip pruning, shoot bending, tip pruning, and defoliation, respectively.

These results are in harmony with the findings of Avery, *et al.* (1979) who mentioned that girdling apple trees resulted in starch accumulation in source leaves, and subsequently accelerated fruit ripening.

D) Total soluble solids

Table (3) shows that all treatments increases total soluble solids in fruit juice but that increase was insignificant in both two seasons. The largest increase was obtained by girdling treatment followed by shoot bending + tip pruning + defoliation one. Combined treatment was more effective in increasing total soluble solids in fruit juice than single ones of shoot bending, tip pruning or defoliation. The higher value of total soluble solids in fruit juice, indicates the faster ripening of fruits. These results are in line with the findings of Avery*, et al*. (1979) for girdling.

E) Acidity percentage and T.S.S. /acid ratio

Although the differences between treatments were insignificant as shown in Table (3) acidity (%) decreased over control as a result of girdling, shoot bending + tip pruning + defoliation, tip pruning + defoliation, and shoot bending + defoliation treatments. Total soluble solids/acid ratio showed the same trend of total soluble solids. The higher ratio was an indicator for the faster ripening of fruit, and it was found that girdling, shoot bending + tip pruning + defoliation, tip pruning + defoliation, and shoot bending + defoliation were the best treatments in that respect. These results are in harmony with what was reported by Avery , *et al.* (1979).

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تـأثير بعض المعـاملات الزراعيـة علـى تكوين البرعـم الزهـرى وعقد الثمـار والـمحصول لأشجار كمثرى "الليكونت"

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أجريت هذه الدراسة على أشجار الكمثرى المثمرة صنف الليكونت (عمر 10 سنوات) بمحطة بحوث البساتين بالقناطر الخيرية ، حيث عوملت الأشجار بالمعاملات الآتية: ثنى الأفرع لتكون قريبة من الوضع الأفقى – إزالة قمم الأفرع الطويلة - ثنى الأفرع + إزالة قمة الأفرع الطويلة – إسقاط الأوراق فى نهاية شهر نوفمبر وذلك بالرش بمحلول اليوريا 10% - ثنى الأفرع + إسقاط الأوراق - إزالة قمم الأفرع الطويلة + إسقاط الأوراق – ثنى الأفرع + إزالة قمة الأفرع الطويلة + إسقاط الأوراق – التحليق للأفرع بسمك 9 مم– المقارنة.
ثنى الأفرع والتحليق تم بعد سبعة أيام من تمام الإزهار –بينما تم إزالة قمم الأفرع الطويلة فى بداية شهر يونيو.

وجد أن جميع المعاملات قللت من طول النموات خاصة معاملة ثنى الأفرع + إزالة قمم الأفرع الطويلة + إسقاط الأوراق – كما إزدادت أعداد الأوراق ومساحة الأوراق- وكانت المعاملات المركبة أفضل من المعاملات الفردية فى ذلك. كما أحدثت هذه المعاملات زيادة فى النسبة المئوية للبراعم الزهرية ونسبة عقد الثمار والمحصول – وكانت أفضلها معاملة ثنى الأفرع + إسقاط الأوراق وإزالة قمم الأفرع الطويلة + إسقاط الأوراق وثنى الأفرع + إزالة قمم الأفرع الطويلة على التوالى. بينما حققت معاملة التحليق أحسن الصفات الثمرية من حيث وزن وحجم وارتفاع وقطر الثمار يليها فى ذلك المعاملات المركبة بينما كانت نتائج - صفات صلابة الثمار ونسبة المواد الصلبة الذائبة والحموضة غير معنوية.

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Table (1): Effect of some cultural practices on pear vegetative growth and flowering during seasons of 1998 and 1999.

Treatments	Shoot length (cm)		Leaves' number crement		Leaf area (cm^2)		Flowered spurs %	
	1998	1999	1998	1999	1998	1999	1998	1999
Shoot bending	36.63	19.80	3.23	3.57	25.40	26.50	67.86	74.58
Tip pruning	26.27	13.77	3.30	3.63	25.90	26.83	65.96	72.36
Shoot b. + tip p.	29.00	14.87	3.37	3.67	26.20	27.20	70.28	77.65
Defoliation	36.13	17.97	3.10	3.47	27.00	28.10	66.43	72.49
Shoot b. + defoliation	35.17	16.90	3.20	3.53	26.30	27.40	71.85	78.94
Tip p. + defoliation	30.33	15.33	3.37	3.63	26.70	27.8	70.59	78.21
Shoot b. + tip p. + defoliation	25.10	12.93	3.43	3.77	27.50	28.63	76.32	81.27
Girdling	33.33	15.63	2.97	3.43	26.10	26.90	68.57	75.81
Control	41.77	23.93	3.00	3.33	23.80	25.30	61.88	67.78
L.S.D. at 5%	2.29	3.86	0.05	0.06	0.62	0.90	1.28	1.31

Table (3): Effect of some cultural practices on pear fruit characteristics during seasons of 1998 and 1999.

Treatments	Fruit weight (gm.)		Fruit volume (ml)		Fruit height (mm)		Fruit diameter (mm)		Fruit firmness lb/Inch^2		T.S.S. %		Acidity %		T.S.S./Acid ratio	
	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999	1998	199 9	1998	1999
Shoot bending	140.82	145.87	133.33	140.00	79.33	82.67	64.67	66.7	12.57	12.43	12.77	12.77	0.213	0.223	59.95	57.26
Tip pruning	136.34	144.97	131.67	138.33	79.00	81.33	64.00	67.33	12.60	12.50	12.70	12.73	0.220	0.230	57.72	55.43
Shoot b. + tip p.	142.42	149.78	135.00	143.33	80.00	82.33	66.33	67.67	12.50	12.30	12.77	12.77	0.210	0.223	60.80	57.26
Defoliation	134.98	143.82	130.00	138.33	78.00	80.67	63.33	67.00	12.63	12.53	12.63	12.67	0.220	0.233	57.40	56.81
Shoot b. + defoliation	142.51	151.49	135.00	143.33	80.67	83.33	67.00	66.00	12.33	12.26	12.80	12.83	0.207	0.220	61.83	58.31
Tip p. + defoliation	145.90	158.20	140.00	151.67	82.33	84.67	67.00	68.00	12.30	12.17	12.83	12.87	0.203	0.220	63.20	58.50
Shoot b. + tip p. + defoliation	158.46	169.41	151.67	160.00	84.00	86.33	68.00	68.33	12.16	12.13	12.93	12.90	0.200	0.217	64.65	59.44
Girdling	163.13	175.69	156.67	165.00	85.00	88.67	68.33	67.33	12.13	12.03	13.03	12.93	0.200	0.210	65.15	61.57
Control	127.46	134.32	121.67	128.67	75.33	77.67	62.00	65.33	12.75	12.56	11.90	12.43	0.223	0.230	53.36	54.04
L.S.D. at 5%	4.93	4.16	4.10	5.93	1.37	1.19	1.16	1.35	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.